Canada Alberta

FOREST RESOURCE DEVELOPMENT AGREEMENT
ENTENTE SUR LA MISE EN VALEUR DES RESSOURCES FORESTIERES

Canada

Alberta

The Canada-Alberta Forest Resource Development Agreement is a subsidiary agreement of the Canada-Alberta Economic and Regional Development Agreement, which provides coordination and cooperation between the governments of Alberta and Canada in areas of Alberta's economic development.

The Canada-Alberta Forest Resource Development Agreement is funded equally by the governments of Canada and Alberta, from April 1, 1984, to March 31, 1989.

Its primary objectives are to ensure the long-term availability of timber supplies; to optimize timber uses; and to contribute to the growth and diversification of Alberta's economy.

The Agreement comprises three programs: Reforestation; Applied research, technology transfer and opportunity identification; and Public information, evaluation and administration. These programs are managed by a joint Directorate and are implemented by Forestry Canada and the Alberta Forest Service.

L'Entente Canada-Alberta sur la mise en valeur des ressources forestières est auxiliaire à l'Entente Canada-Alberta sur le développement économique et régional, qui vise à assurer la coordination et la coopération des deux gouvernements relativement au développement économique de l'Alberta.

L'Entente Canada-Alberta sur la mise en valeur des ressources forestières est financée à parts égales par les gouvernements du Canada et de l'Alberta, et a cours du 1er avril 1984 au 31 mars 1989.

Ses objectifs principaux sont assurer la disponibilité à long terme de réserves de bois; optimiser leur utilisation; et contribuer à la croissance et la diversification de l'économie de la province.

L'Entente comprend trois programmes: Reboisement; Recherche appliquée, transferts de connaissances techniques et relevé des occasions; et Information, évaluation et administration. Ces programmes sont gérés par un Bureau de direction conjoint, et mis en oeuvre par Forêts Canada et le Service forestier de l'Alberta.

For more information, please call or write:

Pour de plus amples informations, veuillez vous adresser à:

Forestry Canada
Northern Forestry Centre
5320 - 122 Street
Edmonton, Alberta
T6H 3S5
Telephone: (403) 435-7210

OR/OU Alberta Department of
Forestry, Lands & Wildlife
9915 - 108 Street
Edmonton, Alberta
T5K 2C9
Telephone: (403) 427-3583

Proceedings
From The

GEOGRAPHIC INFORMATION SYSTEMS CONFERENCE

FORESTRY GIS: THE NEXT STEP

MARCH 9 - 11 1988

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Forestry Canada
Regional Development
5320 - 122nd Street
Edmonton, Alberta
T6H 3S5
Telephone: (403) 435-7210

or

Forestry, Lands and Wildlife
Forest Industry Development Division
108th Street Building
#930, 9942 - 108th Street
Edmonton, Alberta
T5K 2J5
Telephone: (403) 422-7011

FOREWORD

The majority of papers in these proceedings are edited versions of oral presentations that were transcribed from tape recordings of the conference sessions. The editor has made every effort to preserve the content and style of the original presentations, though most of the transcripts have been edited for continuity and readability. Any prepared papers received have been subject to a brief review by the proceedings editor. Each paper has been presented in its submitted form. However, as with every proceedings, there are papers/presentations which do not get submitted in time for publication. If individuals are interested in a session presentation which does not appear in this volume, please direct any queries to the editor or the paper author.

Editor
Neville B. Ferguson
Alberta Forestry, Lands & Wildlife

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DAY 1 - GEOGRAPHIC INFORMATION SYSTEM (GIS) NEEDS:

Fred W. McDougall
Deputy Minister
Alberta Forestry, Lands and Wildlife

WELCOMING ADDRESS[1]

Ladies and Gentlemen, welcome to what is now modestly known as the "City of Champions", an epitaph that I hope will apply following the Stanley Cup playoffs this spring. I would like to begin by first of all congratulating the organizers of the conference for getting such an important and timely meeting held here in Alberta. I think both the timing and the location are very appropriate because our government is trying to establish a set of quite powerful initiatives in the whole area of land information systems and certainly, the application to forest management could not have come at a more appropriate time with the present emphasis that is currently being placed on forest industry development in the province.

In looking at your program, you have an excellent set of speakers and very knowledgeable people, particularly with respect to the application of GIS to forest management. I was very pleased to see Gordan Baskerville for example, and he is just one example of some excellent speakers that are on the program, but Gordan, certainly in terms of application to forest management, is a Canadian authority on that subject and illustrative, I think, of the very high quality of information speakers that you are going to have on the program throughout this conference.

I would like to just briefly describe some of the initiatives that the Department is taking with our new Land Information Services Division, as Ed Kennedy just pointed out, we have pulled together in one place in the Department and basically as a central group in the entire Government of Alberta, a very skilled group of people and I think the critical mass necessary in terms of having the resources to move ahead with these very important and very large initiatives that are required. In fact, I think they have the mandate and they have the skills and I think the only thing lacking now is adequate funding, and Ed is working very hard on that and I am hopeful that we will be successful in getting the necessary increased budgets. These programs, once you get to an applied scale on a province-wide basis, as most of you are already aware, can be very costly to implement.

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[1] Note: Transcribed and edited from tape.

Now we are off to a good start, at least I believe we are, we have with our LRIS program initiatives, begun with the Land Status Automated System some years ago which was put together at a cost of $6 or 7 million and was the automation of our entire public land record system. Up until a few years ago, our public land records were manually entered into large ledgers and manually updated and we were running about six months behind the fact with the hectic activity that the oil and gas industry, for example, imposes on public lands in Alberta. There were many thousands of entries to make every year, we were having trouble keeping it up to date and we were having trouble keeping it accurate. So our first element was put in place and is now operating extremely well with the automation of our land records systems on public lands in the province. We are still developing that area with the addition of on-line capability to our field offices so that public land standings can be obtained accurately from our field offices on line, that initiative should be completed this year.

In addition, several years ago, we began with the establishment of a digitized map base for the entire province at a scale of 1:20,000 and to give you some idea of the cost of these things, we have spent $9 million on that program so far. We've got just about half the province now on a 1:20,000 digitized map base. It will be several years before the map base is completed and at a cost of roughly $20 million.

Our third initiative, Land Titles Automation, which we are proceeding now through the Department of the Attorney General, with the automation of the land titles information in the province. Once again, this will be a very large and very costly initiative and it is now underway - it's just beginning!

And finally, the fourth component in what will give us an integrated system of land information availability and enable us to tie resource information systems, which is your primary interest, into an integrated total network, the final element of that will be the parcel mapping program which has not yet been initiated.

The final cost estimated on getting those four kind of basic land information systems up and running on an operational basis province-wide, is going to be an additional $20 million over and beyond what we have already budgeted in 1:20,000 base mapping in some other programs, which is an awful lot of money! The province is currently, as you know, running a deficit so a new program initiative of that size is not getting quick approval but I can say that, through the efforts of Ed and our Minister, we've had a very positive reception and I'm optimistic that whether we get it this year or next, that the province will proceed with all these major initiatives.

I believe that gives you some outline of the background against which a Forestry GIS system hopefully will evolve and develop, and I think that what we have to look at in bringing in resource information systems is support from industry and other user groups, and I mean positive support in terms of funding commitment and funding assistance as we move along and can show a cost savings in day-to-day resource management decision-making with the implementation of these systems. One of the encouraging things is, for example, Utility companies. When we talk about the LRIS system, they have already come forward and volunteered funding because they can see major cost savings and major efficiencies evolving from the availability of having all of this information available on line in a digitized form. So hopefully, the Forest industry will soon follow suit and we will see the evolvement of a powerful Forestry GIS system within an integrated and efficient network in Alberta, and your deliberations here should do nothing but further that and I compliment you on your interest in this subject which is evidenced by the excellent attendance here today.

Thank you very much!

Dr. Clem. W. Bowman
President
Alberta Research Council

WELCOMING ADDRESS[1]

Frankly, I am astonished that there are 400 people in all of Canada who know what the initials "GIS" and "LRIS" stand for, but there must be 400 and you are all here today and I am very impressed! But really, I am not astonished that a conference on this subject is taking place in Alberta. The province is endowed with large natural resources and when this province assumed ownership of its mineral resources in 1930, it made a commitment that it would protect and manage these to the benefit of the province. Of course, this brought in the need to measure. As you know, there is an old saying that "What you cannot measure, you cannot control". So Alberta has already had a long history of measurement and management of its non-renewable resources. For example, the Alberta Energy Resources Conservation Board has been in the information business for a number of decades and it core storage and data handling protocols have been studied and copied by countries worldwide.

Their renewable resources, as you know, represent a much more complex measurement and control system. The resources keep changing in time with both seasonal and long term harvesting cycles and, therefore, the technologies needed are more complex and require advance computing, modelling and expert systems development. Of course, this why the Alberta Research Council is an active participant in this conference.

The Council was established in the 1920's with an aggressive geological program. Our program was then expanded over the next few decades to diverse research undertakings in both the renewable and the non-renewable resource area and more recently, our interest has expanded into the various high technologies, including micro-electronics, biotechnology, robotics, and expert systems. And as Ed has mentioned, recognising the importance GIS and LRIS, our Board has recently approved the establishment of a new initiative in this area to pull together various GIS-related activities at the Council into a more cohesive program.

Our objective is to merge this new initiative into the comprehensive GIS program that's being undertaken by government departments and by the private sector. What we would like to do, is to work in a joint venture mode with other parties and with our goal being to ensure that technology is transferred to the users in both the government departments and the private sector. And Fred, we do have some funds for this, when joint ventures and joint programs are developed, I think you will find the Council a very willing participant.

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[1] Note: Transcribed and edited from tape.

Thank you -- Good luck in your conference!

Michael Heit
Director of Development
Canadian Forestry Service

WELCOMING ADDRESS[1]

Distinguished Guests, Ladies and Gentlemen. It is a privilege to address this audience for the Federal Government and welcome you to this conference.

Prior to taking the pre-conference workshop the other day, I was going to give you the standard federal address. You know, how the Post Office does it - 9700 Jasper Avenue, followed by an alphanumeric string, however, now that I have taken the workshop and have studied how to address, perhaps, you may want me to give a more technical address on where we are.

The Canadian Forestry Service is pleased to co-sponsor the Second Annual GIS Conference. As some of you know, this is the second conference, with the first one being in Winnipeg (1987). The Winnipeg conference established a high standard in that it had large crowds, great speakers, state of the art discussion and free entertainment. The Winnipeg conference, as I said, was a great conference: it had 280 participants and 10 exhibitors. This one is pushing 400 with 27 exhibitors and there were approximately 170 people who attended the one-day pre-conference workshop.

The purpose of this conference is "technology transfer". Hopefully, you will leave here with a clear picture of GIS, what it can do and what it cannot do. There is a lot of money involved in GIS and the vendors are well aware of that and that's why they're here and that's why we want them here. We wanted to create a situation where consumers are well informed prior to buying. The conference is designed with three components: the needs, which we discuss today; the solutions, which we discuss tomorrow; and the implementation, which we discuss on Friday.

I want to congratulate John Harrower and his staff who carried most of the work for this conference. I also wanted to say that we are holding a conference on April 11 and 14th on Northern Mixed with Management, so if you like this one, hopefully you will be at that one as well, in Edmonton.

I have a few personal comments on the GIS movement. Forestry in Canada, as we know, has an excellent reputation -

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[1] Note: Transcribed and edited from tape.

it's got a worldwide reputation. We do not have to take a back seat to anyone in this field and we can be proud of this. However, forestry in Canada and forest management in Canada has not really been pushed to the limit and I say that because, when you are not banging your head against the annual allowable cut, it's not as tough a job. Of course, with the new investments, particularly here in Alberta, it's going to make it a lot tougher to manage from an information perspective.

Supply management becomes very unforgiving when you lose your fudge factors. Historically, foresters have issued daily supply reports published on the back of Export "A" packages. Today we can issue these same reports using millions of dollars in computer hardware. Let us hope that these expensive reports are more accurate.

Canada exports approximately $16 billion in forest products every year. We also export a lot of know-how and a lot of consultants have a lot of offshore billing and around the world we can compete with the Scandinavians or anyone. Hopefully, out of the GIS movement, Canada will develop and export GIS know-how offshore.

The Canadian Forestry Service has a lot riding on the Geographical Information Systems. We have contributed financially to eight provincial governments for GIS systems in support of one kind or another. This round of agreement is coming to an end and the lobbying has started for next round of agreements, and in particular, with respect to this conference, lobbying has started to give support to GIS and supportive systems. As I said, GIS had better be worth it because when we spend money on GIS, we don't spend money on planting the trees, so there is an opportunity cost.

If you are in forestry like I am, you've probably visited a lot of mills in the last couple of years. One thing that does amaze me when I go through the mill, is the huge capital outlays that have occurred to upgrade mills to make them more efficient. I hope the GIS systems will capitalize the woodlands manager and the field forester so that they too can become more efficient - I see them as parallel movements.

Over the next couple days a lot of wonderful things will be said about GIS, but I believe there are a few obstacles - one particular obstacle that has to be overcome before GIS can meet its potential and I don't think these are technical problems. The more power to the companies - I believe that they are very good at designing the black box to overcome the technical problems and certainly computers are becoming faster and faster. From the last conference to this one for example, we have moved from the 286 chip to the 386 chip and that has a lot of implications for GIS. No - I think the obstacle is different from technical, and I think Jack Dangermond said it best at the Winnipeg conference when he said that (and I believe this is a quote) "Hardware and software are tending toward zero on a cost performance basis. The gold of the system is the data. Yes, the constraint is data. No one institution has the resources to feed GIS with data." If you remember the movie on "JAWS" when they described the shark as being an eating machine, well GIS has a similar appetite for data, and the only solution is data sharing.

We have to move to a situation whereby the federal, provincial and companies move their forestry and related data into the public domain. And I am not talking about published reports and summary reports - I mean the raw data in a machine readable form has to be shared. This is in some ways an attitude problem and in some ways a trust problem. The Canadian Forestry Service is, of course, no better or no worse on this, and I know that from experience. Many times I have tried to pry 1920 data from some researcher and had to convince him that the federal government will not collapse if we release our 1920 PSP plots.

I think the challenge is there to share data and I think we are meeting it. One of the speakers this week will be discussing that point. But as I said, I think data is the problem - we have to share it and I hope we meet that challenge. What good is having a machine that will do ten overlays if your agency only has one set of data. If you can't get the data, buy yourself an onion skin and do one overlay, don't buy a GIS!

With that, I thank you and I welcome you to the conference. Thank you!

Les J. Cooke
President
Urban Regional Information Systems Association

WELCOMING ADDRESS[1]

I would like to extend a welcome to all the participants from the Alberta Chapter of the Urban and Regional Information Systems Association (URISA).

This conference represents a new bench mark in the activities of our Alberta Chapter, in that it is the first time we have worked in the context of a facilitating organization with other groups. Our interest as an organization in a conference like this is strictly from a process viewpoint. We are interested in seeing this kind of communication take place in Alberta and in fact in Western Canada, which will lead to the kind of efficiencies and effectiveness that Michael Heit referred to in his comments. We are firmly convinced that in the field of Geographic Information Systems we can ill afford for each of us basically to invent the wheel on our own. Our interest, in this particular conference, is to bring together all the people who have an interest in Forestry GIS and give them the opportunity to learn from each other and basically to go away with a better understanding perhaps of how GIS technology might relate to them.

I want to put in a brief pitch for URISA. It has been our custom at many of our conferences to in fact include the URISA membership as part of the registration. We didn't do that this time, but I think it is important for everyone here to realise that for our communication to be effective, it has to be ongoing, and I think what we in URISA can provide to people with an interest in information systems, is that ongoing communication. I would encourage you in the course of the next three days to stop by our display in the exhibits area and to seriously consider taking a membership in URISA either personally or from an institutional standpoint. Quite frankly, I think we can demonstrate with our short but action-packed track record over the last two years that the Alberta organization is in fact an effective way to have ongoing communication.

With those few comments, I would like to extend a welcome to everybody again and hope that you have an informative and helpful three days. Thank you!

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[1] Note: Transcribed and edited from tape.

Dr. Gordan L. Baskerville
Dean of Forestry
University of New Brunswick

THEME ADDRESS:

GIS AND THE DECISION MAKING PROCESS

It is really convenient that you folks could all be here this morning. Convenient, because I have an announcement to make, and you are just the right group to hear it. I want to announce that I have the answer!

It is the ultimate in a GIS - the perfect answer to each and every resource problem. This new improved system is at the leading edge of the technology. It is compact, it is complete, it is user friendly, and it is faster than the proverbial speeding bullet. It all fits on a single floppy disc, and runs on a desk top of modest proportions. By virtue of NASA fiberoptics and star wars laser electronics, it does overlays, underlays, and prints 27 colours. It is endowed with artificial intelligence capable of dealing with trees, soils, wildlife, environmental impacts, fish, and the national building code. The system is compatible with all other GIS systems, and its superb artificial intelligence feature will allow a new owner to lay off everyone but the system operator and the driver of the company limousine. Finally, it comes for a new low, low price especially set for this conference.

Ladies and gentlemen, I do have the answer. Now, if only I had the question.

It is common at forestry meetings nowadays to hear people in halls, in booths, and on podiums, earnestly proclaiming the technological excellence of their GIS. The new software and the new hardware is so much better than that old stuff the other guy has. Actually, the technology is developing rapidly, and this is exciting to see. The disturbing element is that examples of progress in using the technology tend to be anecdotal, and seem to relate more to demonstration than to aiding the comprehensive process of forest management decision making.

The theme of the GIS conference is "The Next Step". It is not clear if this is posed as a question - "What Is The Next Step?" - or as a statement of fact - "The Next Step." How confident are you about where GIS stands in assisting forest management today, and how confident are you about what the next step should be? What follows are the views of a person keenly interested in making forest management happen in the forest, and in the application of geographic information systems towards that end.

Any question of real relevance to forest management decision making is complex. It would be nice to tell you the questions can beas simple and systematic as those faced in the mechanics and programming of geographic information systems. To the contrary, the questions, and they are plural, are as complex as the societies, governments, industries, and individuals who collectively use the geographically variable forest resource. That complexity is precisely why GIS technology is so important to the development of forest management. It is also why you should be humble about what you can do to assist the decision making process.

In comparison to the basic questions of forest management, the applications of GIS have been simple and somewhat tentative. Every province or company who owns one will say they use their GIS to manage better, and every province or company will note that others have not been quite so successful. There is lots of propaganda about how good "our" system is, but when you cut through the rhetoric, the demonstratable advances in terms of improved management in the forest are thin. Even allowing for the fact it takes several years to load the data base, the signs of impact of GIS on the design and implementation of forest management are barely visible. Digitized maps are not the product here - the product is better information use in forest management decision making.

One can walk down the hall from the GIS department in forestry agencies and hear horror stories of how GIS gobbles up budget, but does not help solve problems. Given the short history of GIS, that is understandable. First efforts have gone into hardware installation, software debugging, and data loading. There has been a tendency to use GIS to do things we always did, but to do them faster, and neater. My impression of where GIS stands is that outstanding progress has been made in establishing the technology, and in making the technology better, faster and cheaper. Demonstrations of applying the technology to some bits and pieces of management design and management implementation problems have been impressive. It remains to establish a comprehensive connection to the management decision making process.

The introduction of Geographic Information Systems is a teaching-learning experience for both the GIS technocrats, and for those in the decision making process who would use the technology as a decision aid. It is necessary for the GIS technologist to teach the people in the decision making process how the technology can help them. It is necessary for the GIS technologist to learn something of the environment of decision making. It is necessary for the people in the decision making process to teach those in GIS the role of geographic information as it exists in the decision context. It is necessary for the people in the decision making process to learn enough about the capabilities of GIS technology to allow exploration of innovative applications. There has to be a whole lot of teaching, and a whole lot of learning, on both sides.

Learning can only occur when there is recognition of a divergence between expectation and reality. Learning does not always occur with that recognition, but it cannot occur without it. To what degree have you, the practitioners of GIS, matched up expectations for the technology, with reality of its use in forest management? I know you have checked your goals for digitizing maps, loading data files, increasing the speed of map production etc., etc., but that is not my question. I repeat, - to what degree have you, the practitioners of GIS, matched up expectations for the technology with the reality of its use in the design and implementation of forest management?

I cannot do that for you here. Rather, I urge you to examine progress with respect to the end purpose, rather than in terms of mere development of the technology. This will not be easy to do. Even after several years of seeing GIS technology, people in the decision making process have not fully comprehended what it offers them. To be useful, such examination must be done in the unique situation of each GIS installation.

The technology of GIS is not commonplace in the forestry world. This technology' will be developed and improved as a result of competition amongst the manufacturers. The technology will continue to develop independently of how effectively such systems are used in forestry. On the other hand, there must be a special effort, from within the forestry fraternity, on developing the intelligent use of GIS technology in design and implementation of forest management.

Development is needed not just to automate existing tasks, but to do new things not previously possible. The use of geographic information systems in forestry is developing from the top down, perhaps more correctly stated, from the technology down. It is not developing from the need up. Do the folks out in the woods where forest management either occurs, or does not occur, know who you people, here in this room, are? Do the people in the decision making process know who you are? Do they know how you can help? Or are you and your technology just something else that happens to them while they try to get on with their jobs.

The next step must be to ensure this technology is indeed used, and not just exercised in the manner one might take a dog for a walk. That requires firm intellectual contact between the people with the technology, and the people with the problem. The people on the forestry management decision side are a diverse lot, located in a variety of different levels in their organizations. It is not easy to identify the real players - they do not wear numbers, and the program offered in the form of an organization chart can be misleading. It is not easy to get them to a meeting like this one. It is not easy to get an opportunity to talk to them long enough, in sufficient depth, to discover how they assess their information needs. Their interests lie in resource management, not in technology.

For GIS to achieve its potential impact on resource management decisions, the next step must include thoughtful discussion with the people in the decision making process with respect to such matters as the form in which information is passed. The difference between information, and noise, in decision making can be as little as the measure chosen to express the level of an indicator. Indicators and measures which are not conformable to those in the minds of people in the decision process become mere noise - they become noise no matter how elegant the technology involved in their generation.

Repeatedly, I have used the phrase decision making process rather than decision maker. You should be under no illusions that somewhere there lurks an individual called "the decision maker." Management decision making is a process involving many people, and it is not productive to attempt to characterize the decision maker as an average. People in GIS will have to work to discover the connections between their technology and the decision making process in their unique cases.

Use of geographic information systems offer a far more than a technological advance to the mechanics of forest management. This technology opens a whole new philosophical view of forest management. GIS offers an opportunity for qualitative change in the design and implementation of forest management. GIS not only allows faster, better, brighter - it allows different. It allows the opportunity to carry out management planning in a qualitatively different manner. Together, people from the management decision process, and from GIS technology, have to discover the possibilities.

GIS makes it possible for forest policies, management plans, operating plans, and what happens in the forest to be related to one another in a numerically consistent manner. That will be a major change. Provincial forest policies have been based on broad averages more guessed than calculated. Management has been designed from an inventory for a whole forest by averaging types and responses. Silviculture has been practiced at the stand level based on the feel of the forester. Actions taken in the forest were the ones appropriate for the money, people, and equipment available at the time, in the circumstances that prevailed in that part of the forest at the time. It has never been possible to reconcile these diverse levels of spatial perspective.

Characteristically, planning at the policy, management and operational levels has started from unrelated, and relatable data bases because of the different geographic scales involved. Not surprisingly, there is little evidence of consistency of control of development in the forest, with the notions in forest management plans, or of either of these, with forest policies. The inconsistencies of information across the spatial perspectives of these levels makes such a comparison impossible - and in fact, uninteresting.

The inconsistencies of the data structures at different planning levels most often means that the policy, or the management plan, cannot be implemented in the forest. When the folks who actually carry out the 'planned' management come to the forest they confront reality - the forest is not built on average. The qualitative change afforded by this technology is that it is now possible for the information bases for policy, management, operations, and reality to be the same. The aggregation necessary for design of policies and management plans, and the disaggregation necessary for implementation of policies and management plans in the forest, can be made without losing consistency of information content.

The potential is fantastic, but it is still potential. It is still common to see confusion between and among the policy, management, and operational decision levels, emanating from spatially consistent data bases.

To get full value from this technology there is a need to have the ultimate users and the GIS technology people in earnest discussion. Not with respect to how to calculate something, but with respect to what to calculate about. That raises an interesting point. Who do you consider a user? The person who owns a GIS is a user. The person who operates a GIS is a user. The person who uses the output of GIS technology in management decision making is a user. All of these users need to be listened to, but for different reasons, and to get different perspectives.

The starting point in discussions with users from the decision making process end of the scale should be the presumption that, anyone with a grasp of GIS technology, does not know anything about the decision making environment in forest management. Being experienced in both worlds would require two lifetimes. Nothing destroys the credibility of a technology faster than the hotshot technocrat who presumes to know what the lowly manager needs. GIS is hot stuff, but if it is to have the appropriate impact on forest management it is time for science and technology to talk less and listen more.

To determine information needs for resource management decisions you start with the information user. The owner, the operator, the people who use information to make policy decisions, management decisions, and operational decisions, are all users. They sometimes look like the same person, but these are different people, in different geographic locations, with very different spatial perspectives on the forest, and with weak understanding of each others perspectives. The great need is for an information system that retains logical consistency when interrogated from their various spatial perspectives. Such an information system will force a link among these perspectives and, in my view, constitutes the most crucial need in resource management today.

There are barriers to communication with respect to forest management planning. The barriers and confusion exist from the policy level all the way up to the level of what happens in the forest. GIS offers the first ever hard information link from the forest level down to the policy level. Remember, we are trying to control the forest. The forest is the target of policies, and of management design. Policies and plans are nice, but they are just words, they are not reality. Reality is the forest. Having a spatially consistent information link from the forest level down to the policy level makes the process of forest management planning qualitatively different. Whole new approaches to forest management and its relationship to policy and operations have been opened up by GIS.

As you can see I have neither the answer nor the question. The point is that the question should be stated first, and you have the right people here to begin right now. If you get the question stated clearly, the rest is easy.

The next step for forestry GIS is to make itself usable by the management decision making process so that the nature of decisions can change in qualitative form. The aim is not just to make the old form of decisions better, but to assist in making new types of decision. Evolution of management philosophy with the advent of GIS has been slow. At the same time, there are high expectations in the management decision group with respect to what GIS will do for them. GIS is a tool. It is not the answer, but it is a crucially important element in creating the answer. So important, I argue, that the next step should concentrate on establishing a synergism with the management decision process.

Larry Sugarbaker
Assistant Divisional Manager
Department of Natural Resources
Washington State

THEME ADDRESS:

ELEMENTS OF A SUCCESSFUL GIS INSTALLATION IN FORESTRY[1]

I seem to have a habit of picking up interesting reputations in Canada. I appreciate very much the previous speaker's comments, because it's an honour to be able to follow-up and present the kind of information that I feel falls within the kind of guideline and the strategy that's been laid out.

In fifteen minutes, I probably can't adequately cover everything that needs to be covered about how one would go about installing a Geographic Information System or acquiring one or actually running one but what I can do is point out some of the key points and highlight some of the things, I think, that are very important for you to watch for during the next three days. I've looked through the agenda and there are some very good topics that you need to participate in and listen to. The issue of planning for systems and identifying user needs is very essential and looking at the acquisition process, it's a scary moment the day that the hardware shows up on the doorstep and you don't know what to do with. So these are all very important issues that you need to be concerned about and addressing before you leap into a GIS environment.

In addition, one needs to be extremely cautious and careful about looking at the cost benefit analysis, and looking at your organizational strategic and operational plans and saying critically to yourself, "Where does this technology fit in with that? How can I apply this technology to be responsive to what my organization needs to do? Not - how can I push this technology to do what I've been doing? Be somewhat visionary but be careful not to oversell the technology to yourself.

I have a series of about 20 slides that I would like to run through, which gives you a little bit of a perspective about the Washington State Department of Natural Resources and the type of work that we do. Much of our activities revolve around forestry work, however, we are also involved in a number of other areas as well. I will try to address some of the acquisition processes, the implementation work that we've been doing and slip in some antidotes along the way to let you know where we've made some mistakes and where those might positively be avoided.

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[1] Note: Paper transcribed and edited from tape.

The Washington State Department of Natural Resources has management responsibilities for approximately 5 million acres of Trust lands, 3 million acres of that being uplands with nearly 2 million acres being classified as commercial forest lands. The agency manages these lands, in trust, for the various trusts in the State of Washington and it is a multi-billion dollar business. Annually revenues are generated of somewhere between $150 and 200 million. It takes a fairly good size organization to run an operation like this as many of you are well aware.

In November of 1983 a system was installed within the agency to look at some of these issues and to support the strategic goals of the organization, principally, the forest land management program. The system that was acquired was called GEO MAPS, standing for Geographic Multiple-use Analysis and Planning System. This system had a very large job to accomplish due to the fact that historically within the agency there were developed a series of systems which,

a) never quite measured up to what they've been sold to do,

b) they met a limited number of functions, and

c) they supported some aspect of the organization's operation.

For example, the field forester grew very fond of the forest-type map but it had its maintenance problems and it had its problems in supporting things like overall forest harvest planning, and sustainable harvest calculations. That particular system which was used during the '60's was replaced by a newer generation-type map, which showed forest inventory conditions and the advantage of this newer system is that it did support harvest calculations and harvest planning. It didn't, however, provide a very good operational piece of information for the field forester out in the little red truck trying to make decisions on the ground. We also had other automated mapping systems that were principally geared towards publishing maps of various resource conditions, typically soils conditions within the State forest lands.

The forest land management program was adopted in 1984 as a ten-year plan for the organization to manage its forest resources. The key to this was looking at a process that essentially traps the life cycle of the forest from regeneration of a new stand to one-year, five-year, fifteen-year surveys, tracking forest activities, supporting the harvest planning process through the entire cycle until the cycle could begin again. A fairly tall challenge when you have to consider the environmental constraints of the '80's that are affecting how our resources are to be managed.

We were able to acquire a system through a fairly detailed assessment process. We did work with a consultant at the time, we did a workload analysis, we looked at the agency requirements for information (not just at the operational level but at the planning and policy level as well). That work culminated with a request for a proposal that went out and ultimately resulted in the acquisition of a system in November of 1983. That system has since grown from a core centralized system supporting the development of a database to a system that now supports workstations around the State, within each of our seven regions. In addition, within the various divisions within the Olympia Headquarters, there are also workstations that access the system and query databases to assist in the decision making process. One of the key elements here, and I think I'd like to stress this at this time, is that it was one of our objectives to make maintenance of information as close as possible to the user generating the data. So forest inventory data, for example, and silvicultural activity reporting actually occurs at the region level where the information is reported by the field forester.

Obviously, one of the key reasons for using GIS technology as opposed to maybe other database management technology that don't have this spatial component was because of the nature of our work, in which a lot of the information is not tabular in nature, it is spatial, it does need to be referenced to ground locations. Within the State of Washington, we had the challenge of looking at resources on 2 million acres that were scattered around the state. In many cases, we were required to develop state-wide day layers. So a careful system design was critical to establishing a format for how this information would be utilized and accessed in the future. Initially, the statewide dataset then was partitioned into both physical and logical units that could be accessed. In our case, some 2,000 of those files, which we'll call tiles were conceptually layered, several layers deep of various resource themes. You have often heard that data loading side of Geographic Information Systems is the most expensive side. I can assure you that that is true and there are many ways that you can load information, more cost effectively. We can't touch on all of those today but I do have some literature that I would be happy to give to you or if you just drop me a card, I can have it sent to you as well.

We added things like the public land survey as the basenet to start with, and then on top of that, compiled basic ownership records. We are currently in the process of now moving that production project, which is now completed for the state, into the City official land record keepers, where they'll be replacing the traditional vault leather bound velum sheets of information that are the official records for the Agency of Ownership. We are now on a course to replace that manual process. Important to the State of Washington was the resource information data layer and that covering the 3 million upland acres that we manage was largely input by the field people.

Ultimately, what we want to do is to build up an integrated or corporate database that supports the 'dowsion' that everything is accessible and available with everything so that it can answer all questions all the time. It sounds a bit trite maybe, but that ultimately does become the objective. It is important, however, when planning the systems and in selling the idea to your organization, that you carefully phase the implementation and recognize that not everything comes with the hardware. There is a process, an implementation and development phase, which results from the perspective-wise view of what you've actually planned in terms of operations on the ground - how that affects the various resources that you may be impacting.

For us, it was important to look at the issue of cost. We knew that we couldn't sell the system to management on the notion that we would lower our costs, since we did know that overall our operational costs would go up, however, we also knew that our output would go up as well. [2] If you look at this first graph, the yellow and purple are represents the cost of earlier generation systems and an FYAD, which is the first bar there- that represents the cost unadjusted for inflation of operating our resource management systems within the agency, notably, a mapping system and a system we call GRIDS (the Gridded Resource Information Data System) and we shut those systems down systematically as we began developing the newer systems. So fortunately, we had the luxury of not having to run dual systems for a long period of time. The blue cost picks up the cost of installing and implementing and operating the new system - GEO MAPS. As you can see, initially there were a couple spikes that resulted in hardware payoff, we had to pay off some of our hardware contracts, but generally, a fairly steady incline of system costs. Much of this is due to inflation and if you were to project those FYAD numbers up to the current fiscal years, our actual system cost is only about 10% above earlier system costs, but the performance of the system is far superior. We owe a lot of that to the advancing technology that's available to effectively utilize the system as a tool to manage resource information.

If we look at the distribution of those costs, often people ask me "Well, how much of that is equipment, how much of it is software, how much of it is data load, etc. etc." With these graphs, I am only showing a basic breakdown here where the yellow and purple bars are staff salaries and benefits, the red happens to be the supplies and equipment maintenance cost. A very important thing that you have to budget in is equipment maintenance. It'll cost you roughly 1% per month of the amount that you spent on equipment just to maintain it and that can come back to haunt you later if you didn't plan for it. Then the light blue bar on top shows the actual equipment. Expenditure, a key item that I can identify for you is that equipment expenditures are not one-time. We amortize equipment over a five-year period. We have an annual equipment acquisition budget that's roughly 20% of what the initial acquisition cost was and we find that we never have any problems spending that.

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[2] Note: Graphs not available at time of publishing.

I would like to maybe destroy one of the myths of GIS acquisition, and that is that software costs are a major portion of the operating cost of the system. Initially it may be, for the first year, when you are in the acquisition mode, but I looked at the acquisition costs over a six-year period and I noted here that consulting services that were utilized were approximately 2.6% of our six-year operating budget. Software services that were acquired from the vendor were approximately 3.7% and the actual software that we're utilizing is 2.7%. Insignificant, because productivity of software can far outdistance that percentage in a hurry, because, as you may have heard the number 80/20 in the past that initially 80% of your funds will go into data acquisition, 20% into operation. If you are spending 80% of your funds on acquisition, if you have a 10% improvement in software functionality for entering that data, you've wiped out the cost of the software right there.

Then finally, I want to stress the importance of fully understanding the benefits 'for' a system. I am a firm believer that there is no such thing as an intangible benefit. I think there are dollar values that can be attached to all of those seemingly intangible things, and I believe in the State of Washington that has really come home to us in the last two years, where we've settled major lawsuits as a result of mud slides and as a result of fire-fighting policies. Whereby we've paid out millions of dollars to corporations and individuals for the way in which we manage certain things, some of which were seemingly natural events, but ultimately we were determined to be liable for. Thus, things like better stewardship of the land ultimately come down to a dollar value. So I really feel that that's where the real payoff is, but conversely, that's the most difficult one to sell to management. We could pay for our system, based on optimization of pre-commercial thinning alone in our analysis, and that's been proven out in one of our management regions where we increased the present net value of our investment by 270% in one of our regions in one-year thinning operations alone. If you apply that investment increase across the other regions in our thinning operations, we can pay for the system on that particular operation alone. Not to mention the value of supporting harvest planning and environmental planning as it relates to harvesting.

In summary, I would like to stress a few important points that I have made; I believe that proper planning for system acquisition is critical and part of that planning is gaining the proper agency support and one of the ways that you can do that initially is, hopefully your organization has some sort of strategic plan or management plan that it operates under, use that as your guideline, don't go off half-cocked or you won't be listened to. If you can offer solutions for real problems that your organization is facing, you'll be received much better. If you can put dollar values on those and justify the acquisition of those systems in relatively short payoff periods, the better, but don't ignore the long term benefits, because it's some of the long term benefits that are the greatest benefits ultimately.

I believe that it's important to phase implementation of systems - don't ignore what the system ultimately can do as a planning tool but generally accept the notion that your data are/is in terrible shape at this point and that you need to do a lot of work on that to make the tool useful for managing that data in providing the real planning information where the real benefits are.

So within Washington State, I would have to say we really have targeted the bread and butter items first and then we started capturing the longer term planning functions with the system, because as our previous speaker said and I'll close with this as well, "one of the largest problems that we have within organizations, at least in Washington State I believe, is that the data that are used to support the development of policy and the data that are used to develop management plans and the data that are used to carry out operations on the ground, traditionally have been different datasets." One of the objectives of our program is to push and sell the corporate database process, and you can't just push and sell, you have to perform and you have to be able to make that data available in a form that the policy maker can understand. A policy maker doesn't want to see a two inch stack of printout detailing how many acres of ownership by various trusts they have to deal with. They want a one-page summary of all of that information.

So planning for the system, designing a good corporate database and developing a good planning strategy is critical to the implementation of these systems and the details of this, I'm sure you can pick up over the next three days in a number of papers that are going to be presented. Thank you.

PLENARY SESSION I - "HOW TO DETERMINE INFORMATION NEEDS"

Dick Dempster
Forestry Consultant
W. R. Dempster and Associates Ltd.
Edmonton

A PERSPECTIVE ON NEEDS FOR THE INDUSTRIAL FOREST USER

ABSTRACT. Industrial forest planning is categorized into three phases: development, long-term management, and operations. The characteristics of each phase is examined in relation to information needs and priorities. An attempt is made to relate these needs to the logical or probable development of geographic information systems in Alberta.

This speaker can probably most usefully contribute by attempting to relate the land-related information needs of industrial forest planner (in the boreal region in general and Alberta in particular) to the application of geographic information systems.

For this purpose, three phases of industrial planning will be recognized:

1. Pre-allocation development planning (e.g. wood availability and cost components of greenfield or facility-expansion studies, made prior to capital investment, and timber allocation).

2. Long-term management planning (e.g. Management Plans as required by Forest Management Agreements, which under current policy involve a yield plan for at least one rotation plus a 20 year harvest schedule and road development plan).

3. Operational planning and control (e.g. general development plan, road and harvest layout design, detailed cutblock plans, reforestation plan, road maintenance and abandonment plans, scaling, cut-over photography, regeneration surveys).

Pre-allocation development planning typically involve rapid one-time assessments of large areas (which may be in excess of 5 million hectares and 250,000 forest stands). Approximate spatial information is required. Not only is it impossible to access delivered cost without locational data, but investors, banks, and those accountable to shareholders frequently (and justifiably) insist on geographic definition of supply sources.

The most usual provincially-available information is from AFORISM, which is a non-mapping database. This limits the potential for GIS application. Give the rapid and approximate one-time assessments involved in industrial planning, it is unlikely that the private sector can justify the high entry cost of GIS use in this context. The only current exception is thematic mapping of aggregated data, which is relatively inexpensive and can play a very important role in development planning.

Pre-allocation development planning must ultimately be replaced by post-allocation management planning as resources become fully utilized, but in the meantime, increasing scarcity makes this phase of forest planning very important.

Industrial long-term forest management planning involves periodic (ten years maximum) assessment of large areas (typically less than one million hectares). Two of the most important components are long-term yield projections (one to two rotations) and medium-term harvest-scheduling and road development planning. It is interesting and significant to note that at least until now, demands for spatial resolution have been very low. For example, allowable-cut models as used and required by government are non-geographic (i.e., the models do not incorporate locational attributes). At least two of the FMA holders in Alberta have developed harvest-scheduling models recognizing geographic units and attributes, but given the extensive nature of forest management to date, the required forecasts are being achieved with quite simple databases rather than fully-fledged stand-level GIS's.

In Alberta, management planning, GIS potential is restricted to FMA tenures (since this is the only tenure where the industry is responsible). There is no question that the complexity of harvest and access scheduling is increasing as increasing demands force integrated and overlapping use of resources. This would seem likely to result in a need for better and more flexible definition of harvest schedules. Similarly, if a serious investment is made in intensification of a silvicultural management, logically we shall first need more site-specific data for yield planning, and then we shall need the means to manipulate such data.

Thus, although GIS use is currently low in this phase of planning, the potential will probably increase. However, for reasons discussed next, this need will probably be first felt, and first responded to, in the operational planning phase.

Proper operational planning and control involves continual or annual assessment of relatively small areas prior to, and following, harvesting or other treatments. Of a lease area of one million hectares, only 5,000 hectares might be harvested annually, though operational assessment may be required on two to four times the area actually harvested. The forest manager is dealing with multiple layers of spatial information (existing access, forest cover, watercourse, conflicting dispositions, site assessments, proposed roads, proposed cutblocks to name a few), multiple map updates (cut boundaries may be altered many times between preliminary design and actual harvest), and multiple assessments on the same piece of land in a relatively short period (mapping, cruising, site assessment, layout, pre- and post-harvest surveys, scaling, regeneration surveys). The cost of error can be high, and accountability is unavoidable. Hence, there is a need for good resolution and reliability of map data. Unsurprisingly, the process is expensive and time-consuming. The process is common to any operation conducted on a timber licence or permit.

Given these characteristics, the potential for GIS application would seem to be moderately high, and is likely to increase as the cost and availability of micro-based systems continue to improve and the complexity of operations continues to increase. However, the job of operational planning is currently being done, and the planning approvals necessary for industrial operations are being acquired, by and large without GIS. Although some potential users may be swayed by the sheer elegance of these systems, the majority of buyers should or will require demonstration that GIS can do a better job at less cost than current approaches. Hence it is essential, not only that industrial foresters know something about GIS but that proponents of GIS appreciate the nature of planning and decision-making. Hopefully this conference will ensure a better appreciation by all of us.

Frank Hegyi
Director, Inventory Branch
B.C. Ministry of Forests and Lands

BEYOND USER NEEDS: AN OPERATIONAL GIS[1]

I am very pleased to have been invited here to talk to you today about user needs, and the capabilities of Geographic Information Systems. If you are just becoming involved in GIS, you may find my talk quite interesting since I plan on concentrating on what has happened over the past ten/eleven years while we (British Columbia) have been operating in a GIS environment and how reality affected our original thinking, which in many cases was a very sobering experience. I will relate events to you in the terms of an operational forester who hears all about GIS but doesn't have a system, doesn't have any digitized maps but every time he turns around, he hears us talking about GIS.

In British Columbia, there are two things which are talked about a great deal: the first is GIS, and the second is how good Swedish forestry is in comparison to B.C. forestry. In fact, we even had Swedish foresters come out and give lectures on how well they manage and how poorly we do, and we even had it on CBC, so I had this nightmare where a GIS forester and a Swedish forester and the poor lonely (without-GIS) district manager were facing a firing squad. They were all given a last wish. The GIS advocate (GIS forester) said, "One more time, let me talk about what GIS can do for you!". The Swedish forester said, "One more time, let me give a lecture about the merits of Swedish forestry!". And the B.C. district manager said, "Shoot me first, shoot me first!".

Often this is reality, we talk about GIS, we say what it can do and you (the forester) out in the field, say "When can I get to use it?". Hence my talk will be concentrating on the real user. Not the headquarters installation, but the operational forester.

Basically, what we can talk about in 1988 is that we have moved in the past twenty years in forest inventory from saddles to satellites. The technology has moved so fast and it has made a tremendous impact on the forester practicing out in a district and needing forestry information. At a recent meeting in Victoria (the Professional Foresters Annual Meeting), I had the opportunity to meet Gerry Andrews, former Surveyor General for B.C. (Here is a picture taken in 1931 when inventory really started)[2]. Gerry and I compared the techniques we are using - then and today - and it was just like the two of us were sitting in a room and belonging to two different worlds. It was really fascinating!

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[1] Note: Paper transcribed and edited from tape.

We started out initially with maps. Out in the field, foresters managing the land are used to forest cover maps and initially the question was, "Give me maps, updated maps". There is always a tendency of doing GIS for the sake of GIS and we forget why we are using GIS. GIS is really a tool and this is the mentality of a map, but even that has changed now because we are no longer just dealing with maps, we are dealing with information for decision making, 'geo-referenced information'!

Another one of my re-occurring nightmares often relates to when we talk about user needs. Initially, we were dealing with five levels of overlays, then it moved to eight, then it moved to sixteen, and now we are at nineteen and it's still going. So when you really look at how many overlays you will eventually have, you quickly realize that it will never stop, even though, many times you won't need to use all of those data levels for certain decisions, you still will want to pull in another data layer just in case you do look at a GIS, you will have taken into consideration all the scenarios that "might" occur.

It is also important to sort out, often in colour, the different levels for productivity. When we implemented some of this aspect, the colour on one level and perhaps the way we calculate area on another, we may be showing information in one instance in a "vector mode" for the actual mapping and the second level of information (i.e., overlay) in a "raster mode". This can become very confusing.

The cost effectiveness is really the key point. We can produce maps, anybody can produce maps now, almost any GIS can produce maps, but what is very important, is it cost effective? One of the most interesting things happening in B.C. now is we are moving the branch out of digitizing and are now just concentrating on data management and updating the database. So we started contracting out digitizing maps, not just front-end loading but actually giving us the final product. I get a lot of feedback that some contractors cannot afford to do it for the price we are offering. Others are saying, "You're paying too much". If I went on a lowest bid, I would be making money on it, and this is really the true competition and that's when it comes out to be which system is the best. I am not going to talk about the vendors here, only that it is not how much a system costs or how much the hardware or software cost. What is important is whether it is cost effective? Because when it comes down to linking into AEC calculation, yield analysis, and some of the other things Dick Dempster was talking about previously, it is important to be able to link all of the information and make useful decisions. That is when it becomes not a question of whether you can afford to have a GIS, but a question of whether you can afford not to have one.

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[2] Note: Picture not available at time of publication.

When I look at B.C.'s 52 million hectares of forest land, of which we are using 26 million for harvesting, thus about 50% of the productive forest land is netted out. There are opportunities for optimising. In many incidents, we find that just given the AEC, it would appear that we would recommend intensive silviculture to bring up the annual allowable cut and often would be spending a $1 million to do so. Yet, when we look at the geo-referenced information and we do the netting down using a different criteria, we often find that there was no shortage of AEC, now it becomes a question of whether you should spend that $1 million or $2 million in intensive silviculture. When you start utilizing this information in that way, then you know that GIS will pay for itself and become a very valuable tool.

Often, when examining very sensitive areas where harvesting should not take place due to competing resources, we try to get the emotional arguments out of the system and make decisions using proper technical information. This aspect is very important in B.C. B.C. is not flat, it is quite undulating and it has a couple of hills and that affects our planning process, so a map, which is two-dimensional, often gives incomplete information. We are now in the process, operationally (no longer in R & D mode) of calculating wood delivery cost to the mill. We are bringing elevation, slope and aspect into the GIS so that our netting down processes for timber supply analysis and the annual allowable cut calculation brings it into a reality rather than saying "Well, I think that area is operational" - and marking it on a map and then deciding what percentage should we harvest. Elevation, slope and aspect are very important parameters for us in determining whether an area is harvestable.

Another important area that is considered in our yield calculations is corridor analysis. For example, when determining our areas for harvesting, the use of perspective view analysis (looking at an area from different aspects) before we finally complete that yield analysis can be very useful.

These are just a few examples of the type of information we need operationally from our GIS and which we are using now operationally in our yield analysis. For example, illustrating the deer feeding areas in a three-dimensional model. Hence, slope, aspect and elevation are extremely important for us in the allocation of candidate stands for harvesting and in the calculation of wood delivery cost to the mill[3].

The next thing to remember is as soon as you have a map or as soon as you have a geo-referenced forest land information data base, it is out of date. Hence, the next problem is how to keep it up to date. In our GIS, we operationally linked it to a satellite image analysis system. In fact, last week, our Provincial Minister and the Federal Minister signed a Memorandum of Understanding which initiated a very detailed five-year joint research and development program to bring satellite image analysis, artificial intelligence and expert systems into a fully operational scale so that we can be using this technology for updating maps and our information data base. That Memorandum of Understanding is with the Canada Centre for Remote Sensing.

These are just examples of how an operational system is used. It is not good enough for us just to have an image analysis system and then a GIS system, we have to have the two linked together so that annually we can scan the 6,600 maps which cover the province. We have about 4,000 maps now digitized and there's a tremendous demand for that information. Just in the past six months, I had requests for downloading over 2,000 digital maps to our regional district offices and the forestry industry.

We just updated our equipment, and I am not trying to promote any vendors here because I do personally believe in a multi-vendor environment, and in multi-platform environment. We have been using INTERGRAPH equipment since 1978, and are using PAMAP software with it at our headquarters installation. We are also using the INTERPRO 32 for data management. The major significant change we have made is that we've moved from two operational shifts to one, we are no longer digitizing maps and are moving into reviews, applications and the actual use of GIS in the timber supply analysis process. The remaining maps are going to be digitized on contract with the private sector, so we are building up an industry within B.C. (which is becoming multi-vendor in nature).

One of our intentions is to become heavily involved in research work with the Canada Centre for Remote Sensing in the area of artificial intelligence and expert systems, where basically the computer can go through many logical steps and help the person who may not be comfortable working with the computer to answer his or her questions. Hence, bounds or limits are established and there won't be extrapolation outside of the bounds of the data. This is where we have to be very careful because the computer can really mislead you if you are not aware of the limits of the data you are using. With an expert system, we can ensure that the information coming out of the system is technically correct and logical and the system will tell you if your queries are illogical.

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[3] Note: The series of slides used in this presentation were not available at time of publication.

Now I am going to say a little bit about the futuristic aspect of this technology. We are also working on voice application. I am the first one to admit that current technology is not operational at the moment, but I can see that in a few years time, technology will develop and under this Memorandum of Understanding, we definitely are going to be looking at artificial intelligence where you can just talk to the computer, (i.e. "I need an area volume for the Westkettle watershed") and the computer gives you the hard copy output as well as gives you a vocal answer to your questions. I understand that even a Hungarian accent could be translated into almost Canadian.

Another area, we are really looking at, is the networking of our regional and district offices whereby the computers with artificial intelligence will be able to talk to each other. For example, one computer calling another one, asking for records of harvesting and the district computer coming on line and indicating a change in our records such that green areas presently are not being harvested. This is the type of thing whereby, with an expert system, a network of computers can talk to each other. This is not future technology, this is the type of thing we are working on now.

In addition, this is future, probably at least a year away. With computers getting smaller and smaller, I am looking forward to having a forest service truck with a built-in computer and being able to go out and look at a scene where there has been recent harvesting, then stopping the truck, searching the data base, referencing it with satellite data the exact position and finding out if that information is in the system, or you go out and examine a site specific silviculture treatment and from the computer in your truck, get that relevant information, get a map out and the relevant statistics on that specific site.

I have given you some of the examples of what we use operationally in B.C. at this time. Keep in mind, that the hardware/software configuration we have is obtained in such a way that throughput is important for us. We are dealing with over 6,000 maps, more than 19 levels (and it is increasing) and 52 million hectares of forest land. We recently had a case, on the north coast, where the Minister wanted to find out if we could put a new timber harvesting license in there, and I said "Yes, we can get that information. It will take us six months." He said "Well, I am going to make my decision in three, so if you deliver it in six months, don't bother doing it.". This is reality again, so we ended up doing 240 maps in 2-1/2 months, finished them right on time for him. I think that may have helped in getting the present upgrade, because we just got the upgrade immediately after that.

Timely delivery of the information is important and how you use your GIS as a tool and in a cost effective way to provide that information will become an important factor in justifying the need for a GIS. I believe through the free spirit of competition, we will see vendors developing the products you and I need as forest managers to do our jobs. You will be able to purchase the hardware, which is common to most systems, and you will be able to use the various software packages available on your system. I'll just give you an example of how important this is. Overlaying, after you digitize the maps and calculate the areas of resulting polygons, can often depend on what system you're using. We have spent as much as six hours of computing on a very complex map because of the system not being able to run the different types of software used in the analysis.

For example, an algorithm which was developed recently, allowed us to double production, and when we put it on a VACs 8600, it took only three minutes to run. Overnight processing is costing only seven bucks to do overlays. That's the type of cost effectiveness I'm talking about. Even if you have a PC and wanted to run it yourself, just your time watching it would cost you more than what it would in a network atmosphere. This is what we are very careful about, to ensure that we optimize all aspects and use the right equipment for the right purpose. GIS must be put into the proper perspective when you start comparing the different vendors side by side, giving the contract out, delivering the same product, who makes a profit and who doesn't. That is really where I think you will get a true picture of what GIS systems you should be purchasing. I sincerely believe that there is room for all the systems - we definitely are making our data compatible with all the vendors who are currently operating in business. In other words, we download data and we receive data in a common format so that we are not biasing the industry in terms of which vendor we should be going for. We deserve the right to use the vendor we consider most cost effective for our type of operations. Again, this is what one has to keep in kind when you are dealing with, "Beyond User Needs: An Operational GIS".

On that, I think it is time to close. Have a good conference. Thank you very much.

CONCURRENT SESSION I
"DETERMINING INFORMATION NEEDS IN INDUSTRY"

Jack Spencer,
Management Forester
Weyerhaeuser Canada Ltd.
Saskatchewan Division
Prince Albert Pulpwood

GIS NEEDS: A SASKATCHEWAN USER'S STORY

ABSTRACT. There are several important factors that resulted in Weyerhaeuser Canada Ltd.'s (Saskatchewan Division) acquisition in 1987 of a micro based Geographic Information System necessary to meet our short and long term objectives for data management on 3.5 million hectares of forest land.

A simple statement of objectives and expectations provided the direction and allowed us to stay on track while reviewing a sometimes confusing and ever changing technology.

Identification of how and when the implementation will take place has been done. A detailed product specification with input from the potential users will be prepared for the future integration with the Province's mini-based system. Before the end of 1988, two of the original objectives will have been met. Development of the larger long term goal is ongoing with co-operation from the Provincial Forestry Branch.

With a clear understanding of what is available and a simple identification of expectations, we feel that we will reap short term benefits with this technology and, with some planning and forethought, prepare for even more significant longer term gains.

NEEDS AND ACQUISITION

I am pleased to have the opportunity to speak to this conference specifically on GIS application in forestry. I have been following the rapid developments in this field since 1982 but have to say that it has only been in the last year or so that I have seen systems appearing on the market that could perform the type of forestry applications that we wanted at a cost that was palatable to us, a user.

Let me go into a little more detail on the circumstances that last year resulted in our purchase of Digital Resource Systems Ltd.'s micro based GIS, "TERRASOFT." I believe that an understanding of our situation will give you a better appreciation of why we selected what we did, when we did.

On September 9, 1986, Weyerhaeuser Canada Ltd. signed an agreement with the Province of Saskatchewan which granted us forest management responsibilities on a Core Licence Agreement area of 3.5 million hectares. Concern over management of the information associated with such an area of responsibility came to the forefront.

The Province of Saskatchewan has been digitizing its forest inventory, using pen point digitizers since 1980. One to 12:500 scale UTM map sheets cover 100 square kilometers each and contain 25,600 grid points per map. Each grid point is individually assigned the forest covertype attributes of the stand that it overlays. This grid cell or raster data has formed the basis of the Province's reporting system up until now. Using this information base through facilities provided by the Provincial Forestry Branch and the Crown Corporation SASKCOMP, we have been retrieving area/volume summaries for our Licence area for several years. On our Core Licence area, we have the equivalent of 350 whole UTM map sheets all available to us in this grid cell form. I would have to say that the availability of this data was probably the single most important consideration in our proceeding with GIS at this time.

In 1983, the Province of Saskatchewan and the Federal Government entered into a five year Forest Resource Development Agreement (FRDA). In January 1986, the Province in co-operation with the Federal Government under the FRDA program, decided to proceed with the purchase of an ESRI Arc/Info system on a Prime 9650 mini computer.

Also included in the FRDA agreement were provisions for the Government to enter into direct delivery programs with industry in the province. In our early work plans, developed with the CFS, we identified the purchase of a GIS as one of the projects we might wish to have funded under this agreement. The cost of mini based systems at that time, in light of other projects we were interested in pursuing, as well as the associated implementation and maintenance costs of such systems, were deterrent enough that purchase was not pursued at an earlier stage in the agreement.

By January 1987, it was clear that there was an ever increasing proliferation of micro based GIS touting various capabilities and features. Upon closer investigation, it did appear that it warranted a serious look at what the micro based technology had to offer us. While certain that the capabilities of the full mini based systems had not yet arrived on micro, it appeared that there were systems on the market that could help us in our planning and record keeping functions, as well as streamlining our future integration with the provincial GIS thrust.

By February of last year, I had prepared what I considered a very brief summary of functional requirements and a request for proposals in one document. Several key product types expected from a system were outlined but it centered around our three primary requirements.

1. Generation of small scale thematic maps and associated summarized tables from the existing provincial raster data.

2. Retrieval of area and volume information from that data base to aid in harvest planning and preparation of operating plans.

3. Creation of our own vector base of harvesting and reforestation activity information with overlay and update capability to the new Provincial Arc/Info Forest Inventory databases.

The objective then was twofold. We wanted the capability to use the existing "free" grid cell data now, and to build for the eventual integration of our data with the Province's system whose full capability would not be available to us in the near future.

Four vendors, with whom I had been acquainted with before and who in my estimation offered a micro based system that might meet our needs were contacted. All four, of course, were more than eager to respond and felt that they had something to offer.

By April, I had received responses and proposals from all vendors. Prices ranged considerably as did, seemingly, the capabilities. One vendor took what I considered at the time a novel approach, making an offer that I could not refuse. He offered to install the system on our 286 based machine to allow us to try it for a month or so. If we decided to purchase in future, the cost of training and expenses would be credited to the purchase price of the package. As well as allowing us to learn about the individual package, this afforded us the opportunity to have first hand experience at GIS beyond the traditional show and tell at demos and short courses.

The "rental" system was installed in early May. Although impressed with what we saw after a month of trial, we felt that we owed it to the other vendors and more particularly to ourselves to get at least some comparison of what other systems could do with the same data and similar problems. The other vendors were contacted and provided with a floppy disk of the same inventory data. In July, a member of my staff made a whirlwind tour of Edmonton, Toronto and Ottawa to visit the other vendors for a one day "mini bench mark." It might be argued that you could not fairly evaluate a system based on one day, however, to us the results were invaluable.

We felt that the week's effort had accomplished our goal. We had satisfied ourselves that the first system that we had looked at provided us with the best blend of vector display and raster processing capabilities, file management, user friendliness, analytical tools, and cost. It had also been a very interesting learning experience and I would like to emphasize that of all the systems that we looked at, each had some unique feature of superior qualities that forced us to ask ourselves "what are we giving up if we do go with our first choice?". Again, careful scrutinization of what our original objectives and expectations were, confirmed our decision. From our experience, I cannot overemphasize the importance of keeping this clear throughout the review process and on into the implementation process.

It also became apparent through the review, that all vendors are seeking improvement to their systems to meet the needs of their potential clients. New and improved products were on the horizon everywhere, if we could just "hang on". So goes this technology. There comes a time, however, that you have to make the decision and go with it. Nothing is static and to my way of thinking, if you are careful in your planning, are realistic about the life span for a system, and have not invested too heavily in your choice, there is always room to consider improvements down the road. If what you have then is not meeting your current requirements or if something which better meets your needs appears on the market, a change is not out of the question. Obviously, this is not to be considered lightly, though.

At this point, I would like to review with you the four key factors that resulted in our decision to purchase a GIS at this time:

1. New management responsibilities for a large Licence Agreement area.

2. The existence of a forest database in digital form for that Licence area.

3. The availability of a low cost micro based system with capabilities to meet our basic needs.

4. Financial support through the Forest Resource Development Agreement.

IMPLEMENTATION

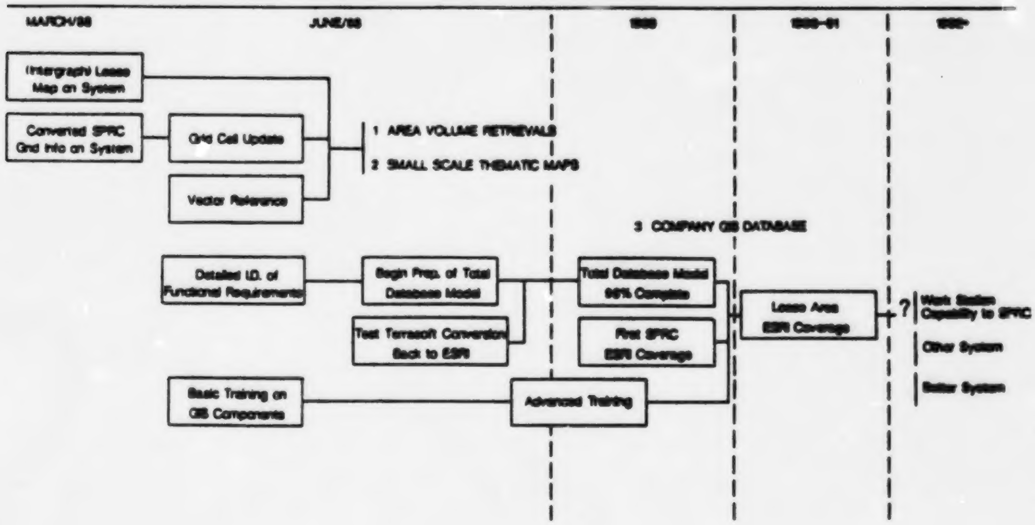
With the decision made, at the "needs and acquisition" phases were essentially complete. By October, we had most of our hardware in place and the entire grid cell database for our Core Licence area had been sent out for conversion. With the experience gained, it had become even more apparent that the implementation phase was crucial and careful planning was required. We did not feel, however, that we required a full time person. This was one of the considerations in the system selection we had made. However, we felt that with help of someone knowledgeable in GIS and, more specifically, experienced in our selected system, that a term position of about one year should result in a successfully implemented system. A round of advertising and interviewing left us with the conclusion, however, that our ideal candidate was not out there and in order to proceed on this vein, substantial investment in time and training for such an individual would be necessary. By January of this year, we made the decision not to proceed in this manner. Rather, we chose to provide the training to a willing member of our permanent staff. We are quite certain that within a slightly longer time frame than had originally been anticipated that we will achieve our functional requirements.

Currently, our implementor is reviewing ancillary software packages and refining our product specifications and user data requirements. Additional training on specific components of the system will occur in the near future. The converted grid cell data for the entire Core Licence area will be loaded onto the system by map sheet and partitioned into usable blocks. The total size of the raw provincial data is 83 megabytes. Contract digitizing of vector reference data such as major waterways and roads, and the UTM grid is being considered. As well, the raster database for a portion of the total area will be brought up-to-date for depletions and excluded areas. By July, we should have the capability to make ad hoc inquiries of the forest inventory database for the purpose of preparing area/volume summaries of specific localized portions on our Licence Area. We should also have the capability to produce small scale thematic maps representing forest covertype attributes such as species association, age, class and site. We will have accomplished two of our original objectives. The database created with the grid cell is essentially a transition product, or building block. Planning for the third, and overall in the long term the most important objective, has begun and will continue simultaneously.

The first step in the planning of our eventual database and linkage to the new provincial system is an indepth review with all our potential users as to exactly what products they want, what they consider most important, and what the output of those products will be. Database design for the system and the anticipated products will begin this spring or early summer. The result will set the priorities, the format, and the content of our input and output procedures. By the end of this year, many of those basic procedures and functions should be in place. Product development will continue as necessary into 1989 and continued product and system improvement will be a priority.

Figure 1

WEYERHAEUSER CANADA LTD.
GIS IMPLEMENTATION TIMELINE


MARCH/88
JUNE/88
1989
1990-91
1992+
(Intergraph) Lease Map on System
Converted SPRC Grid Info on System
Grid Cell Update
Vector Reference
1 AREA VOLUME RETRIEVALS
2 SMALL SCALE THEMATIC MAPS
3 COMPANY GIS DATABASE
Detailed I.D. of Functional Requirements
Begin Prep. of Total Database Model
Test Terrasoft Conversion Back to ESRI
Total Database Model 95% Complete
First SPRC ESRI Coverage
Basic Training on GIS Components
Advanced Training
Lease Area ESRI Coverage
?
Work Station Capability to SPRC
Other System
Better System

Also by the end of 1988, we hope to receive from the Province the first initial coverages of Arc/Info maps that we can convert to our format and incorporate with our developing database. We anticipate that it will be a minimum of three years before we have the entire Arc/Info Based coverage for our Core Licence area.

I should point out at this time that through our entire review of GIS, both at the needs/acquisition phase and now in the implementation phase, we have had the full co-operation of the Provincial Forestry Branch. We have initiated monthly meetings to review each others' progress in an effort to avoid duplication and hopefully to complement each others' efforts. Without such co-operation and a positive approach from the Province, our progress to date could have been limited.

Right now, it is difficult for me to predict where we will be three years from now. Workstation status to the Province's ESRI system for expanded capability cannot be ruled out; however, I feel that might be well into the future. Perhaps the system we have now will have evolved to meet our demands at that time, or perhaps another vendor will better meet our needs. However, I am confident that we have set ourselves a course that will provide not only tangible benefits in the short term but establishes a framework for an ever improving system of information management for the future.

Rick Watson, Forest Planning Manager
Proctor and Gamble Cellulose Ltd.
Grand Prairie

PROCTOR & GAMBLE'S FOREST MANAGEMENT INFORMATION SYSTEM

INFORMATION NEEDS

The company's information needs are summarized as follows:

A. Long Term Strategic Planning

- estimates are required of:
  - i) AAC
  - ii) various wood diet parameters such as sawlog volume, species mix, etc.
  - iii) operational costs based on harvest sequencing plans
- these estimates form the basis of mill expansion plans, development of new products, acquisition of other long term wood sources etc.

B. 10 Year Operational Planning

- estimates are required of:
  - i) annual wood diet detailing parameters such as stem distribution, cull factors, species mix, etc.
  - ii) operational factors including haul costs, summer operable wood, percentage of cut on steep slopes, etc.
- the above estimates influence capital spending in both the sawmill and pulpmill and determines woodlands harvesting and hauling system requirements.

C. Short Term Operational Needs

- estimates are required of all factors listed above under "10 Year Operational Planning" but are now required on a cut block by cut block basis.

- these estimates form the basis of annual budgets and are used in the day to day control of running the business.

PRESENT INFORMATION SYSTEM

Overview

Main points to note are:

1. The system runs on the companies HP 3000 mainframe computer.
2. Assess to the data is through a menu driven program or by directly querying the data base.
3. The data is entered in a traditional manner i.e. not digitized and the system has no mapping capabilities.

Standard Level Data

Forest stands as identified by the province's phase III mapping are the basis of the system. Information about each stand taken directly from AFS types include;

- covertype
- origin date
- slope class
- location (each stand is identified by a 10 digit volume which includes township meridian and range).

Estimates of volume, dbh, etc. are obtained by matching the covertype with covertype profiles (based on the companies psp programming and found within the system). Additional information such as elevation, soil type can also be added to each stand record manually. Stands can be aggregated and wood profile reports generated on the basis of

- geographic area
- slope
- origin date
- covertypes, etc.

Operational Data

In areas scheduled for harvesting in the next 10 years, stands are aggregated into units ranging in size from 50 to 750 ha. The units become the building blocks of a 10 year plan and attached to these records are operational factors such as haul cost, percent summer operable wood, percent commutable wood, etc. The units are grouped by year (and season if desired) and district and reports detailing the annual wood flow for each district and the entire forest management area (FMA) can be obtained.

Long Term Planning Data

The FMA is divided into 52 cut compartments for the purpose of harvest sequencing and AAC determination. Stand level data is aggregated and summary reports of area by age and yield class are obtained for yield projections. Each compartment is also assigned operational factors such as haul cost, percent summer operable wood etc. and these estimates coupled with the land base data are used in a separate p.c. based model to determine the harvest sequence and subsequent AAC.

Summary

1. The user can specify a geographic area by listing stand numbers, entire townships and/or by selecting on specific stand attributes such as covertype, origin date, etc. This process of selection is not as slow as one might suspect.

2. This system is in use and giving us estimates now.

FUTURE PLANS

Although the company will continue to evaluate potential uses of GIS technology, effort will be directly primarily at improving our ability to describe the current and future resource. This resource description is key to all major business decisions such as long term fibre strategy, mill designs and harvesting/hauling systems.

Jerry L. Bauer, RFP Woodland Manager
Canadian Forest Products
Grand Prairie

GIS: IDENTIFYING AND JUSTIFYING THE NEED

ABSTRACT. The foundation of a forest operation in Alberta is the Company's land base and its rights to the timber resource. For an F.M.A. holder, the wise and efficient management of the land base is a key to both the short and long term success of the Company. The demand for faster and more efficient retrieval of resource information and for the ability to integrate or link it with other data bases is greater than ever. Most forest companies can easily identify the need of GIS for land use, annual operating plans and management plans. However, the justification of GIS will be more difficult and may be based on the ability to obtain a suitable and accurate resource data base to run the system and a favorable assessment of the bottom line cost of owning and operating the system.

First of all, I believe the sponsors and organizers of this conference should be thanked for their efforts and work in setting up a conference on such a timely topic as GIS. I have certainly heard and read a lot about GIS lately, and people in our Woodlands Division in Grande Prairie are indicating to me it should definitely be our next step. However, I still have a few concerns and questions that must be discussed and answered before we make a final commitment ot GIS. Hopefully, this conference will aid us in our deliberations.

As my title suggests, we first have to identify our need. I don't believe this will be a difficult task. I am sure all managers and companies recognize the importance of the land base and the timber resource. In Alberta, both the Forest Management Areas and the quota system offers a relatively secure form of tenure for the forest companies. This land base is the foundation of the Company's operations and the wise and efficient management of the land base is key to both the short and long term success of the Company.

In today's world, the question is how do we effectively and efficiently manage the land base and the resource? How do we keep track of all the data? Cut volumes have increased, the level and detail of planning have increased, reforestation is more sophisticated and site specific, however, in many cases staffing levels have actually decreased.

Foresters are constantly dealing with numbers - volume per hectare, trees per cubic meter, stand age, growth rate, percent decay, haul distances, species composition, percent slope, etc. His job is to make maps and photographs, plus a little field reconnaissance when he has time, and create the perfect operating plan, or the perfect management plan, or the perfect reforestation plan; and to do this while maintaining quality, low cost, and keeping all government agencies happy!

For the typical forest company in Alberta, this adds up to a wealth of information and data that has to be obtained, enhanced, reviewed, analyzed, updated, corrected, reviewed again just in order to complete the basic mandate of a Woodlands operation: to get the required volume of timber to the mill site at competitive prices and to carry out basic reforestation responsibilities. Also, the data and information that make up all of our plans have to be presented in a form that is clear, precise and understood by Woodlands Managers, Vice Presidents and the Alberta Forest Service and other government agencies. In the future, this may include the general public. The best ideas and plans are often rejected or questioned only because they were not well presented.

Now, if I assumed that a need for GIS has been identified in a typical Woodlands operation in Alberta, the next step is the justification of the need. I believe this will be more difficult.

My three main concerns for justification of GIS are:

1. A suitable and accurate data base to run the system.
2. The actual cost of owning and operating the system.
3. The effect GIS will have on bottom line cost.

The data base is extremely important and does not just include the timber inventory. If the plan is to integrate and link all the various data bases that we required for a logging or reforestation plan, the data has to be available and it has to be accurate. With present planning procedures, we are continually running into problems with missing, or incomplete, or outdated or incorrect data. The collecting and enhancing of the resource data base to a level suitable for operational planning is time consuming and expensive. It definitely should be done and should be a priority with both government agencies and the forest companies. In fact, is this the first step?

So if the data base is weak, why are we considering a very sophisticated computer program that may have capabilities far beyond the limits of our data? In fact, this could prove to be a very dangerous step. Earlier I said that presentation of information is very important and that good ideas or plans are often wasted by poor presentations. Conversely, the presentation of poor or weak data in a pretty package is not my idea of good planning or work. With a sophisticated GIS system it is important that we guard against the notion that presentation, and not the idea or plan itself is the objective.

My point here is that the total cost of GIS is just not the hardware and software. I believe I can convince my boss to spend $60,000 to $80,000 to buy a microcomputer, a software package, a plotter, etc. to set up a GIS program for our Woodlands in Grande Prairie. I can also probably convince him that it will take a few years to digitize all the maps and to get the system completely operations. But if operational planning is one of my main selling points of GIS, the total cost of the system must include the cost of obtaining and enhancing the detailed data required to run the system. If your timber inventory is weak, if your soil information is weak or missing, if your wildlife populations are not known, the cost of obtaining this data will be many times greater than the purchase cost of GIS.

Now that we are speaking of cost, in the final analysis the justification of GIS for a Woodlands operation has to be based on delivered wood cost. Once we have determined the cost of acquiring the system, and if necessary, enhancing the data base for the system to run on, we have to determine the affect on bottom line - delivered wood cost. In Alberta, the lumber industry is coping with a 15% export tax, limited access to off-shore markets, increasing wood costs, an increasing Canadian dollar, and marginal profits (if any profits, at all). My point is that there is no room in the industry for toys, but there is room for tools that permit foresters to do their job better and more efficiently.

Usually, this means reduced operating costs, and before I go to my boss to seek approval to acquire GIS, and in our case to enhance the data base, I had better be fairly confident of the benefits and the affect on bottom line cost.

In summary, I believe there is room and a need for GIS in our Woodlands Division in Grande Prairie. However, I am not convinced we are ready for it yet. I believe our data base should be our first priority, however, I also see where it may be possible or desirable to handle data enhancement with GIS in place. The suppliers of GIS and my staff will have to convince me that the benefits of GIS are real and can be measured in actual dollars. I might add that I would like to be convinced, and although I may have been a little negative, GIS is probably not that far away for Canfor in Grand Prairie.

CONCURRENT SESSION II
"DETERMINING INFORMATION NEEDS IN GOVERNMENT"

Larry Stanley, Manager
Forest Inventory, Forestry Branch
Saskatchewan Parks, Recreation and Culture

YOU ARE BUYING A GIS! - WHY?

ABSTRACT. Today, many organizations, both public and private, are acquiring GIS technology to augment their data capture and management capabilities. In most cases, this acquisition represents both a significant investment and a dedication to the technological process. Unfortunately, well intended plans often fail due to inadequate or misdirected pre-acquisition analysis of requirements specification and information needs.

This paper reviews the process followed by the Saskatchewan Department of Parks, Recreation and Culture towards defining their information and associated data needs, preparatory to acquiring a GIS. The successes and shortcomings of the process are identified and explained. Recommendations are presented as a guide to those embarking on this process.

So, you want to buy a GIS? The reasons leading to this decision are many and as varied as the organizations making the decision. More often than naught, the decision is based on a hazy notion by someone of what a GIS really is. Often it's predicated on the assumption that "they have one and swear by it." Occasionally, the decision comes through a well thought out evaluation of objectives and alternatives.

We've all heard the cliche that "information is power". I think of that statement, in terms of GIS technology, as saying:

> "basic data is the fuel which drives the GIS engine used to convert the power of data into useful information products necessary for building a sound structure to support management decisions".

Make no mistake about this point. A GIS is strictly a tool to be used as a logical extension of man's natural ability to plan and evaluate options.

It is however, a very versatile tool with many models and attachments. If you don't know the nature of the raw materials you are working with and what it is you ultimately want to build, you may end up buying a sports car to carry coal or a jack-hammer to build a doll house.

You're buying a GIS. Why? Such a simple question, but the details of the answer can have enormous impacts on your organization's future credibility and viability.

In our case, we accepted the challenge and met that question head-on. To begin with, we were no different from any other organizations. A few progressive people felt there had to be a better way of managing, analyzing and presenting our data. We consulted professionals in the date management field and finally decided to investigate the potential of GIS technology.

Support was obtained from senior management. People were assigned to the project and the services of an independent consultant were secured. It is my opinion that the success of the GIS acquisition project within Saskatchewan Parks, Recreation and Culture rests on these simple steps of:

1. involving senior management from the beginning through their understanding and support;

2. establishing an enthusiastic project team;

3. involving an external perspective towards defining our information needs.

One aspect of this process that must be understood is the role of the consultant. The consultant must act only as a catalyst and director throughout the process. It is those people of the organization who will ultimately use the products of the GIS who must clearly identify and reconcile their information needs.

With your organization support and project team in place, the first step in identifying information needs is consolidating the "view from the top." This is particularly important if you're dealing with a multi-faced organization that manages several related resources, all of which will ultimately rely on the GIS capabilities.

Why is it so important to start an information needs assessment at the top? The main reasons revolve around the very nature of a GIS. It is a tool which is most effectively utilized when its development and application is integrated into a corporate structure so as to translate overall policies and objectives into proactive planning information, directly at the professional and technical operations level.

Therefore, it becomes imperative that senior executive management clearly define - to themselves, the project team and, most importantly, to their organization exactly what is perceived as the current and long term:

- operating policies;
- objectives, and
- corporate structure.

The policies and objectives will clearly establish the parameters used to guide the next phase of the information needs assessment. The corporate structure establishes how the GIS will be integrated into your organization and how its operation will be expanded over time.

The next phase can be simply stated as asking the question - What products do you need on your desk to do your job?

It is here in the overall process that the guidance offered by your consultant and project team becomes all important. There are numerous ways of approaching this question but, our experience has proven one method to be highly effective. As the results of data analysis to produce information products will be felt at all levels within an organization, our project team asked key personnel at all levels within our Department to define, through written descriptions and graphic representation, "essential" information products which individuals felt were fundamental to their role within the organization.

No attempt was made to limit individuals during this first pass. Participants were told to consider current products available, modifications on those products and products which are not currently available. The only qualifier placed on the definition of "essential" was that it be a product, without which, the individual could not function in his role, relative to the current and long term policies and objectives of the organization.

It is at this point in the evaluation process that the first real problem becomes apparent. This problem is "human nature." Most people, when confronted with a request to define their job and the information necessary to complete the job, overlook the obvious and proceed directly to the "it would be nice if...." analysis.

For example, within our organization, during the first attempt at this exercise, some 160 individual products were identified by approximately ten people. After an iterative weeding process, this list was reduced to 35 generic products which were eventually used to evaluate and bench mark the various proposing vendors.

The additional 125 products were not abandoned but were compiled into a long term statement of Functional Requirements which could be revised and implemented over time as work on the essential products list is completed.

The moral here is, to reduce the workload for editing out currently unrealistic product demands, it is necessary that those involved in developing product descriptions:

1. concentrate on generic product descriptions without developing variations on the same product theme;

2. recognize a realistic time frame (i.e. 5 years) for development of the products, and

3. have a sense of the relative priority of each product theme towards achieving corporate goals.

During the iterative weeding or editing process, the consultant and project team continuously watched for those products designed more for an automated cartography system. Our view of a Geographic Information System is to maximize the data modelling and analysis capabilities of the system, rather than plotting digital reproductions of non-manipulated, basic input data.

While it would be naive to suggest that this does not occur in some specific cases on our GIS, the premise maintained throughout the information needs assessment was to priorize products requiring multi-data integration and modelling over products developed strictly as digital reproductions of single data themes.

When developing your product descriptions, it is essential that each description format be standardized, since ultimately you will utilize your GIS to assemble the basic product attributes, manipulate both graphic and descriptive attributes to derive the end product and output the product in appropriate graphic and/or list form.

How you standardize your descriptions is not as important as what you standardize. Because the product description process involves people from senior management down to the technician level, there will naturally be diversity in the level of detail presented. From our perspective, we found it most convenient to have each product described by:

1. Title;
2. Map scale of output;
3. Hand drawn description of the graphic product and any associated list output;
4. Legend of symbols;
5. List of data required to make the product;
6. Plain English descriptions of how the product is derived;
7. A description of the end use and name of the end user;
8. A table of when and how frequently the product is required.

Once a series of products has been developed, it becomes important to revisit each product and develop a list of the fundamental data required to produce the total set of products. Don't be tempted to do this before you have established your priorized list of essential products. The aim of developing the essential products list is not to reproduce the same old products you've always manually produced. Just as it isn't your aim to manipulate data into a "pretty" product simply because the data is there. Believe me, the old axiom "garbage in, garbage out" is still as true as ever for electronic data processing. You must guard against the temptation to load the GIS with a large amount of data for which there is no identified use. The input process is costly and ultimately you will create significant storage and processing problems.

In developing the list of data required, it is best to utilize the designated project team rather than the individuals who developed the original products list. If the product development stage was done correctly, then the list of fundamental input data requirements is generally self evident.

There is, however, one caution to be observed at this stage. You must ensure that the consultant becomes fully involved, since many decisions germane to developing the data requirements list will be predicated on a knowledge of the alternate ways of retrieving, layering and combining information through different GIS processing regimes.

In Saskatchewan's case, many products had been traditionally produced using similar data from alternate sources but at different levels of resolution. However, when these products were evaluated from a GIS production perspective, all the alternate input sources (for example, those for the roads or the hydrography layers) were best handled through one or two basic input sources representing a high and an intermediate level of detail resolution. It then became an easy process in reclassifying and eliminating parts of the coverage to produce results at an accepted level of resolution.

When the products have been successfully broken down into their fundamental data requirements, this information must then be displayed in a "data availability table." In its simplest state, this table describes each data source as to:

1. type:
    - map, digital, alphanumeric list.
2. location:
    - where the data is physically located within or outside your organization.
3. scale or level of resolution for graphic data.
4. date:
    - base date of information;
    - date of last updating;
    - frequency of update;
    - if information is not currently available, when will it be produced.
5. data characteristics:
    - number of arcs, line centimeters, points, polygons and alphanumeric characters or bytes associated with the data within a standard partition or unit.
6. product(s) for which the data will be used.

The data availability table provides the last link in defining your information needs before proceeding into the throughput analysis phase. Therefore, it is wise at this point to review and reconcile all the information that has been collected. Revisit your corporate objectives and have them confirmed as written. Review your product descriptions and test their relevancy to stated objectives as well as their priority of development ranking. Check the data availability table and the product generation frequency tables to confirm that all data is available, or will be available, in correct format prior to the required product development date.

When this review is completed, have a senior management representative sign off the package, thereby formally binding the organization to the basic decisions made.

This completes the first phase towards defining your information and associated data needs. It is critical however because it establishes clearly the magnitude of the GIS project required. The next step in the process also hinges on a clear understanding of relationships derived in the information needs assessment. This step is, the development of a throughput analysis.

In the throughput analysis, basic product requirements and data handling loads are laid out on a time line to develop a clear picture of how implementation will proceed. By completing a preliminary throughput analysis before going to the marketplace, you will establish to your own organization and to prospective vendors, a quantified analysis of what realistically is expected from your GIS. The vendor can establish an optimum configuration, based on their system's capabilities and your organization's management obtains a clear picture of the commitment which lies ahead. If then, for any reason, you must start your GIS installation with less than the optimum hardware/software or manpower configuration in your purchased system, determined as necessary by system bench marking to meet a reasonable implementation time frame (for example 5 years), then the effects of any system resources shortfall can be incorporated into a post-acquisition revision of the throughput analysis.

All of this analysis will have to be completed eventually by anyone purchasing a GIS. By taking the time to complete the work before you rush out and purchase a GIS based on the flashiest brochures and sales staff, you are assuring your organization, and the GIS vendors, that you have:

- carefully analyzed your information needs relative to the corporate goals;
- established a priorized statement of that information necessary to achieve those goals;
- gained the best insights and support of all levels within your organization towards making the GIS technology work for the organization;
- established a clear, yet flexible plan of implementation before the system arrives.

In summary, remember a Geographic Information System is strictly a tool to be used as a logical extension of man's natural planning and evaluation abilities. Effective pre-planning of your information needs and implementation strategy ensures an effective integration of this technology into your organization. It will ensure that you obtain what you need to do your job, not what somebody else thinks you want.

Jake Scheffer
Timber Management Branch
Alberta Forest Service

OWNING YOUR USER NEEDS

ABSTRACT. GIS user needs is basically the first step in a system development process. The key to getting the right GIS is to be sure the user properly defines his needs before the system development progresses. The AFS is going to revisit the user needs recently completed to ensure that the GIS we get is what we really need.

Good afternoon ladies and gentlemen. I'm going to start this talk with a disclaimer about myself.

My background in the area of information systems and systems planning is relatively limited. I've taken a few courses in computing and have been involved with looking after one of the forest inventory computer systems for the province. My work with GIS has been the completion of some user needs product descriptions and helping guide some of the AFS involvement in GIS. My viewpoint in this talk will be primarily a set of observations in what user needs are, what is important in user needs and what the AFS user needs study involves.

First of all what user needs are. From what I understand, user needs is identical to the first steps in the development of the computer system. This step is typically called systems analysis - What it is, is the computer guys trying to figure out what us forestry people do. They sit down and describe our system or the way we do work. By calling it "user needs" the roles are reversed slightly in that we and not the computer people are doing the describing of the way we do work, the computer people assist us in this process.

An analogy which could be used is the way we purchase a car. Usually, we have some sort of objective in mind. We know that we need a new car. The first thing you may do is sit back and think about what we need the car for. You have to define your user needs. Simplistically, user needs for a car may be that you may think that you need it to haul wood or to haul people or just to drive around.

A key element in this decision is that it is "your" decision. No one else can decide for you what you really want and need. You take ownership of your needs. I think that this is a key element in systems analysis or user needs. Only you can decide what maps and information you need to do your job, no one else can, especially not someone from outside.

I know that ownership of your user needs is key to developing a system which fits to you. The reason for this is that you want to control the system development process. The best way to control anything is to get in at the beginning of the process. The beginning of the process in AFS's GIS system development is user needs.

With user needs, we went through a process of filling out a series of forms which described the way we will handle our mapped information. The computer guys are using this information to help figure out how to design the system. Systems design is the next step in the systems development process.

This step is the computer guys trying to figure out how they can get the computers to help us do our work. This step may involve prototyping. That means computer people showing us how a computer would do the job we want. For example, with a number of the map products, the AFS has defined a prototype of the product was developed using our GIS. The prototype allows you to see what the GIS can do to deliver the information you are requesting through the user needs. One of the things it helps avoid is this problem: "That's what I asked for but it's not what I want". I call this the analyst's curse. The analyst thinks he knows what you want. And you think he knows what you want. He develops the system and what you ask for isn't really what you want. Prototyping helps avoid this problem by allowing you to try out the system before it is fully developed so that you are clear on what you will be getting when your system is developed. In the system design process, you may purchase or rent a GIS package to allow you to test it out - i.e., prototype before you commit all of your analysis resources to the next step; system development. This is where the programmers write programs which will ultimately make the computer work.

Most GIS packages are canned software. Canned, meaning that programs are already written which will carry out the basic GIS functions. When you buy a GIS, your programmer will probably only have to use the programs already available to create the system you want.

The fourth step in system development is system implementation. This is where we get our hands on the system and actually start operating it. This step can be fraught with difficulties if your user needs has been incorrectly done. In particular, if you haven't had an opportunity to interact with your analysts to control the design, development and GIS purchase process, you may end up with a system which does not work for you.

The last stage, usually the most expensive, is called system maintenance. This is where you have your system going and you need people to run your computers, look after the software and keep the system running. It is known that system maintenance consumes about 70% of your entire system costs. Developing the computer system through the first four stages is only 30% of the cost. I should note here that this is exclusive of data. As you will hear from others, data is very expensive in a GIS. For example, the cost of digitizing our forest inventory in Alberta is upwards of $2 million. I won't dwell any more on system maintenance as this is a topic in one of Friday's sessions.

AFS has gone through a process to define its user needs.

A consultant was hired by the Department's mapping-resource planning area to investigate what it is the AFS and the department of Forestry, Lands and Wildlife does in relation to mapping and land-related information.

We were asked to define what information we needed to complete our work.

We were given a set of definitions of typical GIS processes with which to define information in relation to doing it on a GIS.

This is an example which I filled out for the GIS users' needs study. First of all, this is a map showing the information product I need to do my work. As well, we described a complete legend for the map product.

Secondly, we defined a report or list which we might ask for as derivative of our map product.

There was nothing fancy about this process, but it does provide analysts with useful information as to what we are looking for.

The next steps were a little harder to do but also provided very useful information. We looked at how in GIS jargon this product would be developed. We also looked at the types of information or data required to create this product. Last thing we did was describe in summary the processes and also the number of times we would need a particular product.

All of this information is being used to develop a system which will fit our needs.

The map and steps are used as a guide for analysts to figure out what we want and sort of software to buy. The data and number of projects required are guides to determine which maps should be digitized and how big a machine we need to store data and process maps.

I guess I see nothing magical about this process, it is just a way of doing the first steps in systems analysis or to look at it from a forestry perspective, it is a way to describe what we do with forest maps and information.

This probably isn't the only way of defining needs and in our case, it is just a base for getting an accurate descriptions of what we want.

My observation of the process is that two types of people were involved. Those that took ownership as described before and those that didn't. For those that didn't, there were two basic reasons.

A major one is lack of belief that a GIS will even do what we want. I guess that it presents a challenge to those who market GIS products. They're the ones who have to come out with information that convinces the skeptics that it will work.

Another reason for the lack of ownership is a lack of understanding of the implications of this technology. All I can say, from my brief look into the area, is that GIS represents one of the first opportunities in years for simplifying some aspects of forestry work and freeing up forestry professionals from paperwork. In order to overcome the lack of understanding, I see the challenge with those like myself who are trying to push GIS. We have to help train people and we have to start work on small scale GIS systems which will demonstrate in an operational environment what these systems can do.

What is the next step for the AFS? Right now, we are preparing a plan which will incorporate all GIS activity completed with the AFS so far. The first step in implementing the plan is to ensure we have everybody's needs properly defined. We plan to do this by visiting all of the forests and branches in the AFS and interviewing appropriate personnel.

From this interview process, we will jointly glean out those needs which can most greatly benefit from a GIS and plan for GIS development in those areas.

Two branches in the AFS (Protection and FLU) in a few areas have already gone through this process on their own and are now purchasing micro-GIS systems. They know they can fully justify the purchases in terms of the benefits they will derive.

We hope to use these micro systems and other pilot work we are doing with our natural resources mapping people plus work defining the most C/B GIS products to help justify purchases in other areas.

Our long term objective is to build a full Forestry GIS which will incorporate all of the information products AFS has defined.

In summary, my main points are that:

1) user needs is just another way of describing systems analysis.

2) A key on user side to successful user needs and subsequent system development is ownership of our needs.

3) The AFS is on the road to developing a full Forestry GIS and I believe that we will have one which is very effective because we will get input or user needs from all of the AFS.

PANEL DISCUSSION

INTEGRATION OF INDUSTRY AND GOVERNMENT NEEDS

SUMMARY OF CONCURRENT SESSIONS

Panel Chairman:	Les Cooke Assistant Deputy Minister Alberta Fish and Wildlife

The way we intend to proceed with this session is to have each of the concurrent session moderators give a summary of their particular session. At the end of the two presentations, we'll then throw the floor open to any additional comments, discussion, questions, etc.

I would like to begin now by asking Allan Levinsohn to give a summary of Session 1 which was "Determining Information Needs in Industry".

Allan Levinsohn
Consultant
A.G. Levinsohn, Inc.

SUMMARY

DETERMINING INFORMATION NEEDS IN INDUSTRY

The three speakers all represented industry and what I will try and do is deal with the requirements as identified for each of the individual companies, rather than trying to generalize them, so if there is a little bit of redundancy, you will appreciate why, but it may be worthwhile because it will give us an idea of where there is some commonality and where the stress is.

First of all, one of the companies is actually using a system and went through a process of working with the system on a test basis to see what could be done with the GIS as part of the process of looking at their requirements. They had a two-fold objective: that they wanted to use the system in the interim as a stand alone capability to satisfy some of their immediate concerns and yet at the same time build towards the future provincial system that is being developed by the Province of Saskatchewan. They used it on a trial process to access the systems and conducted a short review of vendor capabilities prior to settling on any particular system.

The four key factors that resulted in the decision to purchase a GIS were:

- new management responsibilities for a large licence agreement area
- the existence of a forest database in digital form for that licence area available from the province
- the availability of a low-cost micro-based system with capabilities that met their basic needs (so the fact that there was affordable technology there, was a key factor in being able to try something)
- they were able to receive financial support through the Forest Resource Development Agreement.

So there was some cost-sharing and some provision of data.

We also determined that one of the companies is looking not so much to acquiring a GIS necessarily but rather looking at the information requirements in general that they have for undertaking forest management activities and their needs fall into three areas:

- the long term strategic management requirement
- the interim planning or the 10 year operating plan environment
- the short term operational needs.

Within that context, they are looking at the available wood to expand a mill or expand production and long term guaranteed wood supply and at what cost and using that as a basis for some harvest sequencing.

In the interim time-frame, they are looking at harvesting hauling systems, changes that may be required to the mill based on the wood that's actually available to them and an analysis of what the wood diet actually looks like, what is the available timber and what kinds of products could be produced and what systems would be necessary to obtain it.

Within the short term operational decision-making, they are really looking at business decisions: the amount of money that has to be paid for various operators for hauling purposes, skidding, felling, etc.

The basic data at the stand level is the AFS stand data from the Phase III using primarily cover-type, origin, slope and stand number, merging that with geographic data and cover-type data. The data are then aggregated to various sizes of units for the three levels of planning that I talked about. So aggregated stand records at the compartment level or at the operating units depending on the planning process that's being used. The bottom line of it from their perspective is they're in no hurry to proceed given that they have a working system now - it's not a GIS, but they have a working information system that's delivering many of the answers that they need for forest management and that they are going to wait and see how things progress - both in terms of the technology and opportunities that may arise to be able to take advantage of a similar situation as has developed in Saskatchewan.

Some of the concerns is the environment within which all of this is being done. Staff cuts will at the same time increase complexity in doing the job, more competitive markets, smaller margins on the products that are being generated and an increasing need to keep track of an ever growing amount of data.

The identification of needs or the requirements issue associated with GIS can be summarized in two parts: one is the identification of the need in terms of what it is you want to be able to do with the GIS and secondly, being able to justify it, and that justification really comes down to the cost of wood delivered to the mill and the effect that spending money on GIS is going to have on that bottom line cost. I think it was well summarized by saying that the forest industry can afford to invest in good tools but certainly not to invest in toys.

Dennis Thompson
Assistant Director
Geoprocessing Services, Land Information Branch
Alberta Forestry, Lands and Wildlife

SUMMARY

DETERMINING INFORMATION NEEDS IN GOVERNMENT

If I wasn't in a position to know better, one would think that we had totally orchestrated this session. However, I know that that's not true, that each of the speakers prepared their papers quite independently but there are a lot of similarities.

In Larry Stanley's case, he touched on a couple of key points. First of all, he made a very strong point to foresters that GIS is a tool. Now if you recall the speeches this morning, you will find that that message was in there as well: that GIS should be a tool. Also, Larry felt quite strongly, as the Saskatchewan government has found, that they need a corporate strategy and that basic data is the fuel for a GIS tool.

It is also interesting to note in Saskatchewan's case, that starting in 1978 when they first looked at GIS, that they had in fact turned it down because they felt that they weren't ready and that industry wasn't ready either. They have found since that time, that there is a real requirement to go through a planned process in determining what your needs are and in Saskatchewan success depended on at least three things:

- Involvement of senior management and that's quite different from approval of senior management. Involvement means that they must be directly involved.
- You also need an enthusiastic project team and here it certainly helps to sell the product if you are convinced that in fact the product works.
- They felt it necessary to have an external perspective and all too often in government, we can take an internal view and I also think myself that sometimes government gets to the point where we don't need anybody out there (we can generate enough paperwork to live just within ourselves). So it was with some conviction that Saskatchewan decided that they needed to bring in some external consulting.

In terms of looking at the needs, Larry's topic was "You Are Buying A GIS - Why? What do you want it for? What do you need it for?" and that the description of your needs was very key to the success of their particular endeavour. So in summary, Larry concluded by saying that "Remember that GIS is a tool and that effective pre-planning ensures success.".

Jake Scheffer, from the Alberta Forest Service, was talking from his perspective on the last number of years. The involvement that he has had in the work that we are doing here in Alberta. He felt that it was very important to know what the user needs are and he made the point quite well that systems people and users are not necessarily talking the same language and that it is important that each the foresters and the technocrats have a better understanding of the other perspective and that can only come with time and with a lot of discussion and interaction. Jake also made the key point that the user needs must be the decision of the forester. In this particular case, looking at forestry as the issue here, you need to take ownership and that no one else can really develop your needs except you 'the forester'.

He then described the various steps that one would go through in terms of implementing a system and in the systems design, he used the phrase "the computer guys are trying to figure out what foresters need in the systems design area". That's not programming that's just the computer people trying to understand what it is that the forester is doing and why they need that system.

Also, there were a couple of points that he made about GIS being oversold. All too often, systems people or vendors go in with a very enthusiastic approach and end up with a couple of problems. First of all, the forester who realizes at the end of an acquisition or some experience with GIS that what you said it would do is not necessarily what it does. This seems to be a common problem that some people have. Also, looking at it from the other side, and trying to emphasize again the fact that foresters need to take ownership to some of this system creation, the question that comes out, "well, that's what I asked for but it's not really what I need", so again, the key point here being interactive communication between people who are developing systems and people who are going to use the systems.

In Jake's case, the particular exercise that he described for us was the project our Department went through in terms of looking at our user needs and found that there were in fact two kinds of people within the Alberta Forest Service: those who did take ownership to the exercise and those who didn't. On the negative side, the ones who didn't - it was from a lack of belief that what was being proposed here would in fact work and in a lot of cases, you can see where, if manual systems had been working for fifty years or for as long as you have been involved with it, then why change it -- "if it ain't broke, don't fix it!".

So in summary, Jake found there were three key areas that the Alberta Forest Service is focussing on -

1) the user needs

2) taking ownership to some of those decisions

3) there does need to be a planned approach.

PANEL DISCUSSION

Chairman: Les J. Cooke
Asst. Deputy Minister
Alberta Fish and Wildlife

Panelists: Allan Levinsohn
Jack Spencer
Rick Watson
Jerry Bauer
Dennis Thompson
Larry Stanley
Jake Scheffer

CHAIRMAN: Before opening it up to any general discussion, assuming that there might any, (it's a very quiet group), I would like to first of all ask the panelists if there were any comments any of them would care to make on what they have heard about the other session. The three people involved in the industry discussion, would any of them care to comment on Dennis' summary or conversely, would either of the two people involved in the government session, care to comment on anything that strikes them about the industry session? Again, I think that you should feel very comfortable about making a comment, I think that the audience would find comments from each of the two sides useful in terms of observations about how the other session went.

PANELIST: I guess from my perspective, I am glad to hear that at least some government people are interested in terms of what industry thinks and looks outside of its own agency to get some opinion. Sometimes, from an industry perspective, you feel that people in the Forest Service, no matter what provincial body they belong to, are somewhere out on Cloud 9 creating endless reams of paper and we really don't understand why, so I'm glad to hear that people are starting to take a little bit of an attitude and saying, "Well, you know let's bring in some outside people to take a more critical view of what's going on", and in fact, we have discussed this before we had our panel discussion and we thought, "Well, maybe we have gotten things backwards here this afternoon and that we should have had three of us industry guys talking about the government people and all the industry people should have been listening to government".

PANELIST: I believe that's a very good statement. You've heard a few minutes ago about the co-ordination that's going on between Weyerhaeuser Canada Ltd. and the Saskatchewan government in terms of development of Geographic Information Systems in Saskatchewan. Now I assure you, Jack and I did not co-ordinate this, but we do maintain in Saskatchewan a very strong association between government development and private industry development, to the point where Jack and his people and my people in government hold regular meetings. We know what each other is doing, we know the lines that we are developing along, we know what the compatibility problems are going to be and where the lines of constructive data exchange are going to occur. We certainly have no problem in terms of our own data for those areas of forest management licence agreement in Saskatchewan and that information is pertinent to the industry within Saskatchewan. Letting them have that information for their own development and use. Conversely on the other side, we have a similar type of reciprocation, where they have information which ultimately comes into our system.

Another aspect of our GIS development within the Government and industry in Saskatchewan is one of a very integrated approach to data management. We are not dealing specifically with forests, we are dealing with forestry, we are dealing with wildlife, fisheries, parks, we are dealing with fire control, resource lands development, a large gambit of operations and when you start talking about that kind of integrated data management and integrated data use, then "yes" private industry does have a very significant role to play. After all, they are charged with the mandate of managing their part of the resource which comes under their licence agreement. So there is no reason why the two sides shouldn't be coming together and I think your comment about government speaking to industry and industry speaking to government, especially in a conference situation like this is very important.

RICHARD SHELFORD: I would like to pose a question to one of the panelists from industry. I believe this morning we heard Fred McDougall indicate or made reference to the NRIS network system and from all indications for industry to become a part of that. I would like to ask those panelists if they have an interest in just the concept and if they do, how does it pertain to GIS and GIS implementations.

PANELIST: I guess long term I would say that we would have an interest in becoming part of that sort of integrated system. In the short term though, I don't see it because one thing that Allan unfortunately missed in his summary but I feel is important, and which two of the forest industry people identified as being real 'key' is looking at the quality of the data that we are generating in the first place and I think some of us have the perspective that before we go out and spend a lot of time, spend a lot of money integrating our data with other types of data and getting a system that covers all the different gabled areas in the Province of Alberta, that we would like to feel a little more comfortable with the quality of the data that we are primarily working with which is the forest stand descriptive-type data. Does that answer your question?

RICHARD SHELFORD: Obviously, I would have to accept it, but I get the feeling from one of your comments that you have an interest in sharing the expertise that you, the industry, have to government. What I see here is the government taking a leadership role in trying to get a network system in place for the betterment of industry and government as well -- I was just trying to find out what your interest was in that role.

PANELIST: I think part of the problem with a forestry perspective is that a lot of times when we look at such a big network such as NRIS, we have a hard time evaluating or trying to rationalize "Well, what does that mean to our bottom line, will our participation in this, will the effort and time that we spend in this result in us seeing some sort of dollar savings?". I mean, that's why we are in business and I suspect that if you compare that with what goes on in the oil and gas industry or as was mentioned earlier today, the utility companies, they do have very definite cost savings that they can identify right now. Sometimes we can't identify them but we admittedly waffle by saying that "Yes, this sounds really interesting but we are scared".

PANELIST: I think just in general terms, CANFOR has a history of willingness to participate in sharing information, but again, the bottom line is we have to have a benefit, so we have to all get the data, is it beneficial to us and what do we have to give in return. If that's a positive point for us, "yes" we share information...we have no problem with that at all.

MICHAEL HEIT: My understanding that in the last session there was a question on the Alberta Agreement which I wasn't around to answer - were there other questions on this subject?

AUDIENCE: The question that we were exploring at the time was in Saskatchewan, we have a company, Weyerhaeuser, who is involved directly with the government and had funds made available to forestry development in the area of GIS, my question was, is there such an arrangement underway in Alberta, is there any industry working with the government to get funding, and if not, why not?

MICHAEL HEIT: Well, let me first of all start off by summarizing the four agreements that I look after. I will go through them and mention our activities on GIS. In Manitoba, (and Bob, I want you to correct me if my numbers are wrong), basically we bought the NESRI system for around $1 million. In Saskatchewan, we bought a NESRI for around $1 million. Weyerhaeuser in Saskatchewan, a micro-GIS, around $70,000, and I think that included a study along with that. In Alberta, two VAX 750's removed from CFS to Alberta Forestry, Lands & Wildlife, and we have one more deal in the works which should be completed this week. The amount of that is not very much, I'll be honest with you, the used 750's are probably $13/14,000 each.

As far as how the agreement works. An agreement is essentially between two governments with proposals brought forward and decisions made on them. To the best of my knowledge, there has not been a proposal brought forward in the Alberta agreement for funding a GIS. The other thing about agreements is that they are five-year agreements, six years counting the payout year and they are planned, of course, prior to that. During the planning of those agreements, in Alberta's view, and the spokesperson for the Alberta government was Fred and a number of other individuals, they didn't put forward an argument that said that we want the dollars available to go into GIS systems. There has been preliminary discussions with a few firms as part of the government role in GIS and in terms of funding, to the best of my knowledge, those proposals have not come forward.

As far as where we go from here, there are a couple of avenues that are open in the Western Diversification Fund. My minister, who is also Minister of Mines, is in the process of signing a memorandum of understanding with the provinces on the Geographic Information System. I think Frank Hegyi mentioned it the other day. Basically, there are other funds available, but the proposal has not been brought forward yet.

AUDIENCE: Jack Spencer made the observation that in Saskatchewan, development and implementation of the GIS system was in large part made feasible by the government-used digital database (correct me if I misquoted you there). In view of that, I wondered if anybody else on the panel would comment or answer this question: Should the government of Alberta load existing stand level forest cover map data into a GIS usable database, or to put that more succinctly, should Phase III maps be digitized?

JAKE SCHEFFER: What we are doing right now is in fact looking at that to determine whether or not it is worthwhile.

One of the things that most of you are aware of is that Phase III forest inventory was started in '72 and was completed essentially in '84. So the most recent information we have is several years out of date. So I guess from that perspective the Phase III is not as up-to-date if we want to put it into a digital system right now. I guess I do see that there are a few areas where the inventory is of high enough quality, (quality being something defined by the foresters in the field, whether or not the information is right), high enough spatial accuracy (in other words, the position of lines on those maps, whether or not it's correct), and then the whole out-of-date factor.

There are some areas in the province where we might look at digitizing existing Phase III data, but beyond that, I believe that for a large portion of the province the existing Phase III is out of date.

FRANK HEGYI: I just have one question to the panel: What comparisons, if any, have you done on cost effectiveness of the different systems? I was in Winnipeg last year. I listened to some very good discussions of user needs, very good discussions on systems capability. What is missing is the cost effectiveness and getting a sort of unbiased view of the different vendors.

I would be interested to know if you have done any comparisons on the cost effectiveness and suggest that perhaps next year when we have a meeting we should be able to do a good evaluation of the cost effectiveness of different systems.

JAKE SCHEFFER: One of the things that the Alberta Forest Service has asked the Land Information Branch to do for us is look at the ability of micro-Geographic Information Systems to handle the types of work that we would like to do with a Geographic Information System.

In my talk, I mentioned that there is a very high level of interest in micro-GIS out there right now, and I think that in the Forest Service that there are a number of areas that could very effectively benefit from micro-GIS. So what they've done is taken existing micro-GIS software packages that are on the market right now and have sent each vendor a bench mark test of a series our user needs product descriptions and having the vendors go through the process of not only digitizing, but trying out their system on our requirements and showing us the results.

At the end of the study, we actually want them to come to us, probably through some sort of vendor forum which we are planning for later this spring, that will give us the opportunity to have a look and see just what these systems can do and how effectively they will operate in an operational environment.

CHAIRMAN: Can we get some comments from one of the fellows in the private sector. This cost effectiveness is your bottom line.

PANELIST: Quite frankly, we did not look at that. I have to readily admit that we did not use that to weigh the value of one system against the other. What we were looking at is what system has the best blend of qualities to meet the three basic things that we wanted to do.

CHAIRMAN: Any other comment from an industry spokesman?

PANELIST: Just briefly, we are just in the process of looking at GIS systems. I would say that, in frank terms, we are open for business, so if there are some suppliers out there who want to come and see us and tell us how effective their systems are, we'll listen at any time and any place.

PANELIST: I am not from government, I am from industry, but I think in terms of cost effectiveness and from an industrial perspective, I would like to stress, the idea of cost effectiveness not so much in terms of how much does it cost you to make a map but what does that do to your bottom line as a result of making that map, as a result of having this GIS system. Are your bottom line costs any better? Because if it is costing you more to manage the forest and you are not doing any better of a job, why do you have it?

FRANK HEGYI: I challenge that because, you will find that over the long run most vendors can do similar things. I think now we need to give due respect to the vendors, I am convinced that the technology is going to develop to the point where GIS can do capability studies. The big question will be "Can you stay in business without that capability?" And I think that in government, we should pay attention to this.

PANELIST: I guess I'd turn that around and instead of saying "Can we stay in business with it? - Do we need it to stay in business?" Certainly from my perspective as an industrial forester, it's not important. If I can do my job, if we accept the premise that all GIS is, is a tool, and I can perform my job, make some bottom line profit for the company and meet all the requirements of forest management as outlined in our forest management agreement, then why do I need a GIS system, if it's going to cost me more money? There's got to be some profit incentive there for a company to buy into this.

CHAIRMAN: There was one other hand up in the panel there, and I would like that person go ahead.

PANELIST: I just wanted to clarify - I didn't want to give anybody the impression that we are not interested in cost effectiveness. Our agreement with the Saskatchewan government - our forest management agreement - entails that the province will supply us free of charge with forest inventory data and that's the forest inventory we use. They prepare the maps, they prepare the inventory - we're really a user. So cost effectiveness of preparing inventory, preparing maps was not really a question to us.

CHAIRMAN: Any other questions or comments from the audience?

BASIL DELANEY: This is a question that was stimulated by the discussion in the industry session. Jerry Bauer, from CanFor, mentioned that a concern he had was the accuracy of database, not only for covertype but for other data base such as wildlife and soil. It just happens that the Chairman is the Head of Fish and Wildlife Division so perhaps you could respond to this question, "Do you see that there are some vehicles or avenues for data transfer of available data bases from Fish and Wildlife to the private sector in order that they can use such information in their forest management requirements?".

CHAIRMAN: That's throwing it back. The problem with Wildlife information does not have anything to do with a willingness or non-willingness to make the information available. It has to do with what information exists, in what form, how transferrable is it. In fact, it is my belief and I am only recently in the position as Head of Fish and Wildlife, that information is quite a serious problem for Fish and Wildlife managers in Alberta, I think I can probably safely say, in Western North America.

I think that the problem stems, quite frankly, from the failure, until really the last 20 years to recognize the relationships between land and wildlife resources and in most organizations in Western North America, the concept of a habitat organization of any sort is really a relatively new concept. Traditionally, information gathering efforts in Fish and Wildlife have concentrated on the resource itself. We actually survey the number of animals, we count fish, etc. That information, while it is important to a wildlife manager and means something to them, is something less than useful to a land manager because in fact someone provides some interpretation of what those numbers mean in terms of how a land manager should behave. If someone doesn't provide that interpretation, the information is pretty close to useless. What's happened is that we have to really, and we are still very much at an early stage of this, redefine what it is that we need from the standpoint of wildlife information. If we are talking about what information is useful to a forest land manager, we have to have the ability to provide them with habitat-related information - things that are of consequence to land management.

I believe that we are at a point where there really isn't anything to give a forest land manager at the present time. I also believe that nobody is going to hand us $30 or $40 million and say "Go out there and come back with the habitat information that we need to do all of these various jobs related to forest land management". Just as I don't think governments will ever again give us that much money to do an inventory of anything. I mean the forest inventory, the Phase III forest inventories cost is in total $35 million. There is no way governments are ever going to do that again. Not because it was a bad approach, but because in fact, looking at the cost effectiveness, you have to wonder, are there more innovative ways to do those types of inventories today.

The future for wildlife related information as it relates to land management, comes from building on the information that others gather. Quite frankly, what we are going to be spending our time and money doing is looking at how do we take existing soils information, existing forest cover information, perhaps supplementing it in a reasonable but probably relatively small way, and then generating the kind of habitat information that is useful to a forest land manager.

One of the reasons why our organization in Alberta is keenly interested in GIS is the idea of being able to manipulate other bits of baseline information to create another dataset. The most efficient and effective way to do that today and perhaps in realistic terms, the only way to do it today, is in the process of a GIS. That's in fact, maybe part of the solution to our data needs problem.

The short answer to the question you asked was that we don't have the information to give the forest land manager so we are not too concerned at the present time about willingness to give it. We are very much still in the "by gosh, by golly" sort of period of doing these things. I am not suggesting that there will always be a problem. I mean a lot of what gets done in land management is based on experience and that intuitive capability that comes from a good land manager on the ground. Both our biological staff and our technical staff have that capability. But what we do not have at the present time is clarity in terms of what constitutes a good habitat information system for Alberta, but I think that we are not far away from being able to define what that will be, then the challenge is going to be "How do we get it?". I really believe that GIS may well be the vehicle for generating it. Small example: Can you imagine trying to take the existing Phase III in a manual form and work that through for the province? That's just an unbelievably difficult task. The only way we can ever start to manipulate that information from a habitat standpoint is if it exists in an automated environment.

So I don't know, Bas, if that answers the question directly, but I tried to give you some insight into where the thinking is at the present time, at least in relation to the wildlife component of natural resource information.

Any other questions, comments?

I'd like to thank Dennis, Allan and the panel members very much for the excellent presentations. I think Allan and Dennis did a marvelous job in summarizing those sessions.

Thank you very much for your kind attention.

DAY 2 - GEOGRAPHIC INFORMATION SYSTEMS (GIS) SOLUTIONS:

PLENARY SESSION II - "STATE OF THE ART AND COST/BENEFITS"

Alex Miller
President
Environmental Systems Research Institute
(Canada) Limited

WHAT SOLUTIONS ARE AVAILABLE TODAY[1]

When I was trying to put together a presentation for today and trying to think of how I could talk about solutions that are available, I thought back to last year and the questions that were asked of me in Manitoba and questions that were asked on a continuous basis over the last year. One of the things that seem to be very confusing is hardware - what hardware to use, and not so much what brand of hardware but what architecture of hardware. So in my presentation, I am going to start out by talking about the various hardware architectures and then talk about software trends and then talk about what I see emerging from this conference as one of the issues is application development and modelling: modelling as a decision support tool.

HARDWARE

The GIS hardware technology has emerged in a number of architectures: micro-computers, specifically what we refer to as PC's, are a relatively new development, workstations, mini-computers, mainframes and network systems.

Micro-computers

GIS and micro-computers I would like to think of as a methodology of implementing desktop GIS. The cost of the hardware is relatively low - you can buy an entry level PC-AT for about $5,000 and go up to a COMPAC 386 in the $20,000 range. One of the advantages is it's reliable, standard hardware, can be fixed anywhere and easy to maintain. One of the real drawbacks of micros is that they're single user, single tasking systems. There's a 640 kilobytes program under MS-DOS which makes software development difficult and I think that GIS micro-computers are suitable for stand-alone systems (development of a system that can stand all by itself). One of the advantages is that other applications software is available, so if someone who wants to make the computer a multi-use system PC has got a great advantage. But disk storage is limited, 300 megabytes is about the top end of the micro-computer storage.

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[1] Note: Paper transcribed and edited from tape.

Workstations & Personal Computers

The distinction between workstations and PC's is starting to blur, so I decided to call it "deskside GIS" - usually the workstation processor is usually to big to sit on top of the desk. The cost is moderate: $30 - 60,000 for the hardware. One of the things that workstations have is very fast, high resolution graphics, that is really one of the things that distinguishes workstations from a PC. Very powerful processors, typically between 3 and 10 mips and later this year, it is expected that the mip rating will rise to as high 30 to 50. You have to be careful with mips because some people have defined "mips" as "meaningless indicator of performance" - so it can be taken with a grain of salt.

Most of these systems of multi-tasking operating systems, although they are still single user systems, you at least can do several tasks at the same time. The window user interface is another distinguishing factor in a workstation - ex-windows is a standard that is emerging being used by all workstation vendors. Most workstations have built-in networking. Two standards that are emerging are something called Transmission Control Protocol Internet Protocol and Network File System. Both of these are used to connect different brands of computers together into a single network. So standards are emerging - TCPIP and Network File System and UNEX and Ex-windows are four standards which have clearly emerged in this area.

Workstations really provide the power to do interactive modelling. That's something that has not really been available before in the GIS world is the ability to do interactive modelling. Workstations provide quite large disk storage, in fact, the latest workstations go up to 1.3 gigabytes of disk, which is really what you used to get with mainframes just a few years ago.

Mini-computers

Mini-computers are very much still the standard tool for implementing GIS because GIS tends to be corporate in nature. You
deal with data that's shared by many departments and in forestry the inventory is something that is used by many different parts of the organization. Mini-computers have the disadvantage, I suppose, to a certain extent of high initial cost. The long term cost is no higher than workstations but generally the entry level is about $250,000 and can go up to - I cut off at $1,500,000 for

a 20 work station system. The distinguishing difference between mini-computers and workstations is that mini-computers use low-cost asynchrones graphic terminals, like Techtronix terminals or Techtronix clones or medium-cost Ethernet graphics terminals. This is a very new development graphics terminals that run on Ethernet and provide higher or faster graphics.

Mini-computers still have very powerful processors, the low-end ones are about 3 mips, all the way up to 25 mips but the thing that distinguishes them clearly from micros and workstations is their high speed input/output capability. As a result of their high speed i/o, they generally have very large storage (an entry level mini-computer has as much as 1,000 megabytes per disk, 1 gigabyte per disk). The advantage is centralized control and storage so making them particularly suitable for multi-user access.

Mainframes

Mainframes are probably of less interest to the forestry community than they are to other organizations because they are very high cost. I don't need to put numbers down because a mainframe is generally in the $2 - 5 million range just for the processor, but they are suitable for supporting huge databases. IBM mainframes in particular have high-cost graphics terminals but mainframes are developed and are particularly suitable for transaction processing and in forestry, we really don't see a lot of interactive transaction processing. The transactions that take place in forestry are generally annual updates.

Network Systems

There are really four kinds of network systems: there is something that I call 'homogeneous networks' which is a single brand of computer connected into a network or there are multi-vendor networks where you have multiple brands of computers connected into a single network. Something that's starting to emerge is workstation fileservers. One of the disadvantages of workstations in the past has been that they don't share data very well. Everybody has their own workstation with their own disk. That is solved in part by a workstation fileserver. It is generally a large workstation without any monitor on it that all the other workstations are connected to and all the disk storage is on the fileserver, or a highbred mini-computers with workstations using workstations connected to mini-computers. A good example in this area is the DEC VAX with their VAX station which is a workstation that's a little different from others in that it doesn't run Unex, it runs DEC's own operating system.

Networks can be local area networks, generally using Ethernet or they can be wide area networks using something called LAN bridges (local area network bridges). Again, almost a new development in the last few months where the LAN bridge connects two Ethernet networks over huge areas including satellite links so that you can actually have a logical local area network spread over a wide area. More typically, wide area networks are implemented just with modems where people have graphics terminals or terminals connected to host computers using modems. So network systems are suitable for distributed systems and remote processing so delivery of GIS to district and regional offices or where analysis wants to be done in remote areas.

Just to summarize the hardware, it's entirely dependent on the application and on the number of people who are going to be accessing a GIS database as to which architecture is chosen.

SOFTWARE

In software, life is a little bit simpler, although not much. So I am going to mention some general software trends in the software industry at the moment, a little bit about GIS tools and something that is relatively new, Database Management System Interface tools and finally, talk about some application development tools.

General Software Trends

Some general software trends and this is not limited by any stretch of the imagination to GIS, it is a trend towards more packaging. Back in the early days of computing, almost all software was custom developed. People hired a softwarehouse who came in and developed their accounting package and the trend got towards packaged software. Micro-computers took us to the ultimate where the package was sealed up in plastic with a license stuck right inside, you just ripped it open and away you went. This is a trend that is moving up into larger computers as well. With more packaging, we need greater reliability in the software because packaged software starts to get cheap and you can't afford to support software that has bugs in it. People have come to expect bug-free software, because most micro-software is bug-free. This has put a big load on the software developers because software is now much more complex and powerful, which means that more software engineering is required to make it work. Users are expecting more sophisticated user interfaces. The PC world has spoiled everybody for user interfaces and typical mini-computer and mainframe user interface now look pretty 'conky' in comparison to micros.

There is a trend in application development towards fourth generation languages, which is a badly overused term but there is a new term coming out that will eventually be more overused, "computer aided software engineering" (having computers design software).

Another trend is the emergence of IBM structured query language as a method of accessing data in database management systems. Commonly pronounced "sequel" it really is emerging as a standard.

Finally, a major trend towards hardware independence. Many of the large database management systems are now running on as many as 20 hardware platforms.

GIS Tools

I thought I would just briefly go over what some of the GIS tools are. In the GIS toolbox, one of the first is input of geographic data and I don't really think we have seen an awful lot of improvement in this area over the last year, even over the last couple of years, because this is something that everybody concentrated on in the early days of GIS, digitizing - getting the data in.

Scanning is still around although scanning requires the use of homogeneous data - only forest and polygons on a map, scanners are still too dumb to recognize text.

Remote sensing integration is growing although the role of remote sensing is beginning to be questioned a little bit, particularly with the demise of one of the large Canadian remote sensing companies.

A more popular approach or an emerging approach is 'conversion', base-mapping organizations that are building base-maps as a basis for forestry don't always use the same kind of GIS that foresters use, so, data conversion.

Database Management System Interface Tools

Management of data sets is becoming an increasing problem as data sets get large, for instance, the Province of New Brunswick has now got their inventory completely loaded and it's pretty big - it's probably 1 to 1-1/2 million polygons and over 2,000 map sheets, so map libraries that provide continuous coverage are now a standard part of GIS.

Real time topological editing for updates - avoiding cleaning and re-cleaning a coverage.

In analysis, I think there are four distinct types of GIS analyses that have emerged:

- spatial query, - 'saying what is around it, what is near it and report on it'
- attribute query - 'what do I have and report on it'

- polygon processing
- network analysis.

Finally, display and output - we are getting more interactive map composition. If we think of a map as not a drawing but a report out of a database, the report that comes out of the database may not be exactly the way we wish to present it, so we have interactive map composition tools. These have been driven because of the very, very powerful colour display devices. Last week, I saw an 11 x 17 inch colour postscript output device and it was 300 dots per inch in colour and it just like offset printed output and the printer that did it was only about $30,000. Postscript output is another popular method of getting maps into offset print-ready form.

Finally, something that we are doing, is draping of two-dimensional maps on to three dimensional digital terrain models to produce three dimensional displays.

One of the big developments for our organization over the last year and in the database management system field in general is relational database interfaces. One of the popular mainframe and PC packages has been a package called "FOCUS". Another one is a package called "INGRES" and I see in the newspaper that INGRES and FOCUS have gone together to create what they call 'gateways' between their systems, so a lot of the interface tools provide interfaces to a variety of database management systems. For GIS this is quite 'key' as it allows external storage of attributes. It's not always, in fact very rarely is it, desirable to store very large numbers of attributes within a GIS, they are quite often managed by another system so connection to remote tabular databases is provided by interface tools. This really starts to allow distributed databases. A package like ORACLE has built-in networking capabilities that allow you to store part of a database on one machine and part of a database on another machine. The interface tools provide access to databases and provide something called 'user views'. A user view is something that doesn't exist in a database but a user can see items within the data base without having to be in the data base.

In our own software product ARC/INFO, we have developed a considerably more powerful macro-programming language, something that we call AML that provides the ability to write more sophisticated applications and part of AML is something that we call 'configurable user interface capability' - the ability for a user who simply can edit ASCI files to create pulldown menus and popout menus and screen forms. One of advantages of an interface to a system like ORACLE is the use of the tabular fourth generation language systems. ORACLE has something called SQL form that allows very rapid creation of forms and prototyping and language systems interfaces. And finally, the beginning emergence of computer-rated software engineering tools.

Application Development Tools

One of the things Dr. Baskerville talked about yesterday was the GIS technocrats being remote from the users and I think this is absolutely true, there is a gap that has to be bridged and I think that this gap can be bridged through the development of modelling tools. Modelling quite often is done in people's minds by experienced modelling experts. In the '70's, linear programming models were developed to build economic models and one of the things that we have to do in GIS is to build interfaces to those linear programming models, interfaces to growth models, networking models, terrain modelling, economic models.

We have got to distinguish between modelling and other operations. In the modelling world, the map is a model. GIS builds a model of reality and we can have logical models or mathematical models. So GIS operations on the other hand are data manipulation, data viewing or building of relationships, building map topology.

It is important to note that there are several categories of modelling which vary in sophistication and depend on the application but one of the key things is that GIS manipulations, per se, are not modelling. For instance, a modelling application - a GIS manipulation - might be, show me all the soil type A, whereas a model is reclassification of soils into erosion potential. There is no such data as erosion potential but the model has created our soil suitability.

So we could use logical and arithmetic tables to apply Boolcan logic and decision tables to come up with something, for instance, land capability and suitability.

We could use flow models through networks, hydrological models are one of the most common type of network models predicting runoff. There is a package called HECK, (I forgot what it stands for but the US military developed it to do backwater analysis) that again is an imperfect model because it doesn't have geographic databases which look at permeability of surface, slope and so on and so forth.

- Meteorological models
- Diffusion models
- Air pollution and so forth.

Allocation models are something that is increasingly being used in forestry. Allocation of the resource to where it is being used: where to put a mill or how long a mill will last with the resources allocated to it.

Routing models - routing through a road network or routing through a region or optimal route for pipelines or transmission lines or in the case of forestry - roads.

Site selection models - optimising the site selected based on things like transportation cost, spatial relationships between resources and labour costs. This is something where the GIS can be used and can be a very powerful underlying source of data for the model.

Economic input/output models - Particularly become powerful when combined with spatial considerations and other considerations such as environmental. One of the disadvantages of the linear programming models that are typically used in forestry is the spatial relations must be pre-determined and input before the GIS can provide that input to a linear model.

Finally, if we look at the kind of models that are mostly being used, the static deterministic, in other words, determining a model that is static -- that's what most GIS's are right now is storing static data and they have become well accepted and well refined.

Simulation modelling requires a dynamic model and it's very complex, it's not really used that much with GIS. One that I've been involved in recently is development of a transportation modelling system that models the dynamics of traffic flow.

Modelling interaction between systems, combining separate spatial models. The remote sensing model is very different from the topological GIS model, so clearly there is a model that has to be developed that determines that relationship, and we've really only barely begun development. The GIS companies and remote sensing companies are talking about interfaces - moving data back and forth. Acceptance of this really depends on the model validation and we are calling this an inexpensive alternative to experience. Experience meaning someone who knows multiple systems.

So the models do inform and support decision makers. The decision support system relies on models but there is really little development that has been done in this area and still little acceptance. People tend not to rely on computer models.

What are the future prospects for geographic information modelling systems technology? Dr. Baskerville said yesterday that unfortunately the foresters in the GIS world were being technology driven. This is probably going to continue as people develop more sophisticated technology, but it has to become need-driven. Data is becoming available. One of the problems five years ago in the GIS world was that there was no data and it was a five to ten year program to develop. So there are a lot of development needs still in this area.

Really, what we need is sound geographic databases - we've got to solve our existing problems and realise that GIS availability leads to better databases. With that, I think I will conclude.

John Mostert
President
Intergraph Canada Ltd.

TECHNOLOGY: THE GIS FRAMEWORK

I must admit it is intimidating to stand in front of a group of foresters: forestry is something I know very little about and that's intimidating in itself.

When I was thinking about what I might say to this group this morning, I decided to relate a little story to you. It's about the two California balloonists who decided on a beautiful Saturday morning to go for a balloon ride. So they left and waved goodbye to their families and were aloft about an hour when the weather started to change quite drastically. The clouds started to roll in, you could hear some thunder in the distance, they couldn't see the ground any more. They got buffeted by the rain and the wind and they really didn't know what to do - they weren't that experienced. They persevered and about 1-1/2 hours later, as the fog started to clear a little bit, they could see a half ton truck about 1,000 feet below. So the pilot skillfully manoeuvred the balloon close to the truck, within shouting distance (he could see two fellows standing beside that truck) and he said, "Excuse me, can you tell me where I am?" The fellow beside the truck looked up and said, "Yes, you are in a balloon." Just then the wind blew them away and he didn't have chance for a second conversation and he said to his co-pilot, "You know, that man is an accountant" and the co-pilot said, "Now how can you tell that?" He said, "Because what he told me is exactly precise and accurate but totally irrelevant."

I sincerely hope that my comments this morning on technology are both precise and accurate and will add relevancy to some of the things that you face on a day-to-basis when you make decisions. You know I dashed in here this morning, and I wandered through the exhibits and it totally baffles me because technology changes so quickly today. We live in a world where technology changes once every two years and yet we look at the context of GIS that you work in and a GIS system by its very nature tends to span a time dimension of 10 to 20 years in data collection. How do you bring these two together? How do you take technology cycles that change so rapidly and match them to a GIS system that has a lifespan that starts somewhere in the past and heads somewhere in the future? A difficult and tough decision and when you are talking about technology, boy! The two things you really want to do is preserve your investment - look for strategies to preserve your investment and that technology, and to look for ways to ensure continuity. There's nothing worse than developing a system and hitting a dead end - you can't do that extra little bit that you wanted to do that's paramount to the whole system being justified. Because of the nature of the business you are in, which is collecting data over years - masses of data - technology as a framework becomes an even more important question. I would like to touch on some of those aspects a bit this morning.

I think what illustrates the problem from my perspective as a technologist in looking at systems, is that the hardware costs and software costs have been continually decreasing. The world of the PC has changed the way we look at costs and cost benefits and that component, that percentage, that part of the iceberg that sits above the water is a very small capital cost today relative to your real investment in training, methods, software, data collection, all of the things you've built over the years that really constitute where your investment in technology is. The part above the surface of the water tends to change very rapidly and so the strategy in dealing with technology and the importance of technology as a framework is to come to the right conclusions, to make sure that you are not dead-ended, to ensure that you can preserve that continuity. This is fundamentally important, in dealing with the GIS system.

This year we just concluded the largest project we, at Intergraph, have ever undertaken in Canada, and that was to develop a Geographic Information System for the energy sector. We saw some real opportunities in the energy sector, being that that's a fundamental component of our economy in the province of Alberta, and so we set out to work with a real live customer in partnership with him and with our sister company, VISITECH, (the software development agency that worked on this). In the analysis, we found out an interesting thing about GIS systems that I think is common to all GIS systems: 70% of a geo-scientist's time is spent collecting and normalizing data so that he can do something with the other 25% he has left in the form of analysis.

Most of the focus that has typically been spent in terms of computer science development, software development, has dealt with that 25% (better algorithms, better techniques to analyze the data), and we've failed to focus on that the major cost component, the major area for strategic benefit, that 75% which involves collecting and correlating data quickly so that we can do meaningful analysis. So 75% - data collection/data management, 25% - analysis. The objective of our project with Canadian Occidental was to inverse those numbers.

Let's focus on building a system that takes 25% of the time to collect and correlate the data, leaving the other 75% available for analysis and more detailed study, and let's not limit the analysis component to techniques that we develop or we have come up with - let's simply leave that open to the world because there are a lot of clever people developing better algorithms to do a job better and they should plug into the system to help analysis to take place, depending on the need of the geo-scientist.

So in the traditional working environment of the geologist and moving into the automated world where we can build a continuous base map and the geologists can go down and do his picks and do contouring access (access a contouring package to do contouring), address the needs of the petrophysicist with down hole data (i.e., the log data) and of course, the geophysicist and his science and the type of data that he deals with. In addition, look at the land department - the land department needs to know what land they hold, where those holdings are, where the adjacent holdings are. These four disciplines generally come together in a Geographic Information System environment, each with their own data types, each with their own individual analysis and coordinated into an overall 'play' that gives a new meaning to integration of that information so that it can make relative sense.

The point I would make here is that we tend to focus on the analysis of data, or the analytical tools for an end user situation and that happens to be very unique to a specific unique user. The GIS solutions that are available to us in forestry may very well be different from the GIS solutions available in municipal applications or in energy applications, so you should not get too hung up on the analytical techniques, we should focus more on the most costly component of the problem and that's the data collection and the data management phase, and you've got to have the right technology framework in place to do that.

When I spoke of a world as a continuum and when we add technology to an existing science, we really are entering a fabric of time - time that spans backwards and time that goes forwards. We need to be able to deal very efficiently and effectively with the traditional data collection techniques and if that involves converting standard paper maps through the form of a digitizer, we need to make sure that that data collection process is as efficient as it can be with digitizing techniques.

We also need to be conscious that the data collection comes from different sources and so if that data comes from survey instrumentation or standard photogrammetric type instrumentation, then we need to be able to harness our technology, our interfaces into the past in order to be able to collect that data efficiently and bring it into the GIS system. This deals with that 75% of the data collection component.

We also need to be conscious of the technology of today, the tools of today that are here today such as new types of analytical stereo plotters.

Importantly, we need to keep an open mind and be very flexible to the emerging technologies of the future. Remote sense data as in this example[2], the types of data that's being made available to us through remote sense and the new technology of scanning. It's these two technologies that hold the greatest promise for reducing that 75% upfront cost of building a GIS system and effecting the cost benefits of a GIS system.

I believe firmly that every GIS system has to adopt this concept, this total concept that we call IMAP, which deals with the four principal features:

- Input of data
- Management of data
- Analysis of data
- Presentation of the data.

It's those four key points that make up a total GIS system and to base a decision on only analysis or to base a decision on only presentation, which by far are where the main benefits come from, you can't really look at the cost structure of a GIS without looking at those other components, and the efficiency that you can build into those other components.

There are really two key things that I would like to focus on and that were mentioned by Alex in his talk: the network and the emergence of the engineering workstation, which is not that popular today or not that well understood. I would like to spend a bit of time talking about the significance of those developments to GIS technology.

One of the interesting things about GIS systems is that by their very nature, they tend to be distributed. At least in the final sense they tend to be distributed, initially, they may be very centralized in the data collection phase - collecting the data, developing the procedures in an R&D environment and once those procedures are 'put to bed' and we have something that's more user friendly, we can then start to distribute it into the user community, but ultimately, it typically starts off as centralized and moves out into a distributed environment.

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[2] Note: The series of slides were not available at time of publication.

Hence, we need a mechanism for distribution, and we call that mechanism for distribution "the network". The network is really the backbone, the spinal cord that links the various technology modules together, whether they be input modules, analysis modules, or presentation modules. The beauty of the network is that it is built on international standards, as Alex has already pointed out, and the beauty of international standards, is that its life cycle is starting to approximate the 10 to 20 year life cycle of a GIS. So strategically then, using a network that is built on these standards, allows us to move the risk factor downstream and starts to bring some normalization between the life cycle of a network and the life cycle of a GIS system. So it's fundamentally important you pick the right network!

There are various types of networks: there are Ethernets, there are 'token ring networks' and there are 'star land networks' to mention a few. It's a complex subject and it's probably one that can be the focus of a whole area of discussion in itself. I only wanted to emphasize the importance of the network as a key technological component, one that you will want to be very conscious of as you make technology decisions in regard to GIS.

We often think of a network as a means for sharing data, and certainly that's its principal use, but there are three other things that the network does, and one is, it allows us to contain technology change within a workstation or within a processing or presentation mode. The network route will remain standard and so the limit of risk of obsolescence is really contained at a 'node level' as opposed to the whole system. I can recall ten years ago in this business, when you wanted to upgrade your system, you came back to us and you said "I want to trade the whole thing in". "The PDP 1170 and all of the stations that I bought from you, I need to trade them in and update my technology." The world won't stand for that philosophy anymore, and so today it is possible with a network architecture to be able to contain those technologies to modules that attach to the network and you limit your risk to only those pieces that you need to upgrade that are important to you at the time.

The other thing that a network allows us to do is to share very costly peripheral processing devices. The most meaningful output that I have seen today from a GIS system is a colour electrostatic plotter -- 400 dots per inch. Beautiful output, extremely expensive - $150,000 typically for a colour electrostatic plotter. Not one that you can afford to put on every PC or on every workstation. So the ability to share those high cost peripheral devices on a network regardless of where it sits on the network, is a great advantage.

Finally, when we talk about the network, we need to talk about the management component of data, because if we spent a good deal of time collecting that data, our problem now potentially changes. It's not a collection problem anymore, it's a management problem, because of the nature of the data, or the volume of the data that we're dealing with. So we have to be very careful in our technology decision to ensure that along with the collection of the data, we have the network management facilities to manage that data so that we don't end up with a 'cluge' after it's all finished.

Traditionally, most of the processing that was done in GIS systems of five to ten years ago, was done on a host computer with non-intelligent terminals, as indicated by the "grey" versus the intelligence of the "red" host[3].

We've seen that change drastically with the PC and we've seen PC-based solutions and we're starting to see the emergence of network PC solutions into a host, where the host now becomes the data manager and the PC or the distributed processing node becomes the processor for user specific analysis. We typically thought of that in the context of a personal computer sitting on your desk. The engineering workstation, as it's been called in the industry, is nothing more than a PC for scientific applications. Its architecture is significantly different from a standard PC, in that it makes it ideal for the numerous types of applications, such as GIS and engineering analysis.

These devices differ in that PCs tend to be 16 bit devices, workstations by their very nature are 32 bit devices. Now a simple analogy is that's a 4 cylinder engine versus an 8 cylinder engine. It gives us a lot more capacity to do a lot more processing to handle the types of very intense scientific calculations that are the norm in GIS-type applications. But the more important fact about the 32 bit versus the 16 bit, is that traditionally, engineering scientific software has been written for a large processor and it typically deals with large datasets, and large and complex programs. When you try and convert that large dataset and large complex programs into a PC environment, you have to do a lot of re-writing. The migration is not that portable.

If we now introduce a PC to the engineer sitting at his desk, which has a 32 bit architecture, that portation, that availability to move software which is traditionally run in a mainframe environment, down to the engineer's desk, with much greater ease and the ability to take engineering scientific programmers who are used to dealing with the resources of a large machine and put them on a workstation to develop software for the workstation, this opens up the flood gates for a whole new generation of software.

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[3] References to slides.

That doesn't mean that GIS applications can't perform well on a PC, I am not saying that at all and certainly for the types of applications that we tend to do, PCs with their performance level and their power, perform extremely well. But if we look into the future, into this continuum, where we are injecting technology, looking into scanning applications, and if we look into the introduction of some of the remote sense applications, we do need the horsepower, we do need the ability to write very complex software and deal with very large datasets and we'd like to able to do that on our desk. So whereas a PC is typically limited to smaller programs and smaller datasets, an engineering workstation now can do the same thing that a host can largely do, which is deal with large datasets and large complex applications.

So if you are looking at preserving your investment, you really ought to look at the differences between a workstation and a PC and find out which is more useful to your application before buying into the next generation of technology change as it emerges. Now that's a generic statement and each individual case deserves individual attention, but the key benefit of an engineering workstation, is that it does allow us to look ahead and start to address some applications which typically were not possible before on a PC platform.

In this particular case where our engineering workstations are now, we have all of the horsepower, we have all of the memory, all of the disk storage available on the workstation to allow us to interface scanners directly into the workstation. Just three years ago, we found that we had to interface scanners into a VAX 785, a very large mainframe mini to be able to have the horsepower and resources to be able to deal with scanning data and that has now moved down on to this platform.

Equally well, we have the capability to move a very complex output presentation processing, driving a colour electrostatic plotter down into a workstation environment. That again, was something that typically had to be done either on a very large mini or on a separate special box split off to the side - very costly.

So in the end, the presentation of data, the collection of data, your investment in what that baseline technology is - be it a PC or be it workstation - will give you some degree of what your useful life of that technology will be and coupled with the network, of course, the right network will start to extend the useful life and start to bring these two diverse time spans closer together.

Just some examples - these are screen shots of the kind of quality that we've been used to with the technical publishing market and desktop publishing that we see now becoming very popular and as we start to adapt to these visual standards, we will want them as part of our presentation, part of our final output.

So the "what you see, is what you get" style of image processing on the screen output to the final output devices is becoming more of an important issue today.

To quickly summarize, I think when you look at a GIS system and you look at technology as a framework to a GIS, you really need to look at in the context of an IMAP concept

- Input
- Management of data
- Analysis
- Presentation of the data.

I think that a GIS, in order to be useful has to be both effective in terms of its analysis, but efficient in terms of the collection of the data and the cost associated with that collection. So really, what we ought to do is focus a good deal of energy on that 75% of the problem which is the most costly - the data collection and the data management issue, as well as the 25% that we typically focus on.

I think that the technology platforms that we choose need to protect your investment in technology and it has to do that in the dimension of time. I also think that the most important thing that you need to do within the context of the GIS is to preserve that continuity from the past into the future, with the data, the methods and your real investment in the people who work with your systems. Two of the key technology components that make up that technology framework today, two of the most important I feel are the concept of the network and the concept of the engineering workstation. Thank you very much!

C. E. Barnicoat
Executive Director
Automated Information Systems
Alberta Energy/Forestry, Lands and Wildlife

SELLING THE BENEFITS

ABSTRACT. Spurred by the lowering costs of technology, and the increasing demand for innovative solutions that require the integration of many different sources of information, the demand for automation will continue to grow. However, there is a recessionary attitude among executives that demand cost reduction and leads to the deferral of decisions that require new investment. In this situation, managers must learn to 'sell' automation and make information an executive responsibility. Nowhere is this truer than in the area of Geographic Information Systems where the scope and scale of operations are vast, with extended times for delivery of fully operational systems.

BACKGROUND

In relatively few years, the industrialized world has reached a position in which corporations and governments cannot function without computers. This dependence has been fostered by the lowering cost of computer technology, and by the increasing demand for quicker and more complex decisions that can only be made after the analysis of considerable amounts of information from varied sources. It has also been fostered by the media who have prompted computers as indicators of a well run business, particularly since the advent of the micro-computer.

As a result of these factors and increasing personnel costs, there is no feasible alternative to information automation. Furthermore, there is no intrinsic limit to the work that can be accomplished as a result of automation. Therefore the demand for automation will continue to grow. However, there have been many failures in past automation attempts and executives are becoming increasingly skeptical about proposals for new initiatives. In fact, there is a recessionary attitude among executives today that demands cost reduction, and leads to preference for the deferral of decisions that require new investment.

Added to this, most executives avoid participation in computer issues despite the enthusiasm of many middle level managers for information automation. Why? Part of the problem is undoubtedly a lack of understanding in the technology, and technical managers have not helped by their use of jargon in their presentations. Fear is another contributor. Most executives received their education at a time when computers were not universally available, yet recent graduates act as if they were given computers in their cradles. No executive wants to look like a fool while grappling with this technology in front of these kids. Of course, other priorities such as staying in business and running the organization effectively compete for time too. However, I suggest that the chief cause of distrust is lack of effective communication.

GETTING EXECUTIVE COMMITMENT

Managers who want to gain the support of executives for new information automation initiatives must:

- identify issues that are of concern to the organization and are linked to the organization's business plan;

- present the issues in business terms, not technical ones;

- demonstrate the bottom line impact of the investments in terms that are familiar to the executive, particularly financial terms;

- compare the organization's investment level with those of similar organizations to give the executives a sense of comfort that they are only out of line if it is strategically important. The latter is a particular issue for governments concerning Geographic Information Systems because of their responsibilities in land management in Canada. It is strategically important to government and private sector organizations that adequate and comparable land information be available.

Strategic issues to stress in proposals are:

COMPETITION - Automated systems may allow an organization to differentiate itself or its products in the market and thus retain or gain market share. A striking example of this has been American Airlines who dramatically increased their market share at the expense of competitors by developing the SABRE system to handle flight reservations, and then giving it to travel agents. Geographic Information System promise to provide a competitive advantage to forest product companies, and to all organizations dealing with the development of natural resources.

PRODUCTIVITY - The cost of staff, particularly professional staff, is still rising at better than the rate of inflation, but the cost of computer equipment and storage devices is falling by between 20% and 40% per year. This promises lower costs for information storage, and it can be accessed easily from many parts of an organization to improve the quality and speed of decisions. As an example, Alberta Energy/Forestry, Lands and Wildlife has implemented a land management system within the last 2 years which has allowed a 10-fold increase in land searches, with a 20% staff reduction. From a systems stand-point, the Department has achieved close to a 50% improvement in systems maintenance productivity over the last 3 years.

MAKE THE ORGANIZATIONAL STRUCTURE WORK - The politics of organizational change make all executives cringe, yet in today's volatile markets all organizations must make such changes quite frequently. This is equally true of public and private sector organizations. Automation can foster organizational renewal without loss of control.

As an example, Alberta Energy re-organized its Energy Revenues Division to meet the requirements of the changing Canadian energy environment, and was praised by the Government auditors for increased control despite the temporary disruptions of the re-organization. Geographic Information Systems promise to provide current information at the place where the decision is to be made not at some centralized location.

A STRATEGIC PLAN

To introduce the benefits of automation into an organization in a managed and effective manner requires access to the executives to determine their priorities, and the development of a strategic systems plan which is linked to the organization's business plan. The discussion of this plan in business terms goes a long way to gaining the commitment and support of the system users and the organization's executives. This plan should contain:

ECONOMIC JUSTIFICATION - This will provide a baseline assessment of the current system investments and answer such questions as "What are we spending?" and "Why are we spending so much?".

A COMPETITIVE ASSESSMENT - This will look at competitive or similar organizations to answer the question "Are we spending the right amount?". As a rule of thumb, organizations can expect to spend 1% of the total corporate revenues on automated information processing. However, mature industries and very small organizations often spend less, while service organizations including governments, and those in competitive consumer environments such as banks, often spend much more.

A STRATEGIC ASSESSMENT - This answers the question "Are we spending on the right things?" and must be closely associated with the organization's business plan. In fact, when automation provides strategic advantage, as in the case of American Airlines, the systems plan may alter the business plan.

TECHNICAL DIRECTION - A common vision of the technical direction with estimated costs and benefits will go a long way to creating and maintaining executive support in tough times and good times.

DIRECTION SETTING - Both private and public sector organizations must react to changing economic and policy regimes. As an example, Alberta Energy is using its integrated data on oil and gas to analyze energy policy alternatives at a time of very rapid change in the world energy situation. Automated systems allow the executives of all organizations to regularly and easily measure the business, and to take rapid remedial action when the situation warrants it.

Alberta Energy/Forestry, Lands and Wildlife has developed and maintained a strategic systems plan since 1980. During that time, the systems budget has increased by over 200% even though systems development and operations costs have been reduced by over 50%. Executive support for such growth could not have been sustained without a visible plan which is presented annually for approval to the Executive Committee. This committee has demanded a semi-annual update, with an open invitation to return with extraordinary items that affect the whole organization. Now that the investments are beginning to pay off as promised, the executives are beginning to take a positive interest in automation and to believe in the benefits it can bring to our organization.

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Doug Stewart
Manager of Information Services
MacMillan Bloedel
Nanaimo, B.C.

CONVINCING THE ORGANIZATION

My topic today is "Convincing the Organization". In thinking about this title, I immediately assumed that I would talk about how to convince senior management to buy a GIS, which would lead to talking about specific hard benefits to be gained by buying one. Then I thought that by the second day of a conference like this one, you would have heard lots on that subject already. So I decided to try to touch on some of the aspects of the process of convincing the organization. Sometimes what you say isn't as important as who you say it to, and when.

So who should we be convincing?

Everyone in the organization who will have any contact with a proposed GIS must be convinced of its value, from end-users through operations staff and system support staff through to senior management.

For one thing, if everyone who will be in direct contact with the system is in favour of its acquisition, it will make it easier to get approval to buy. What is equally as important is that if anyone in any of these groups is opposed to GIS acquisition, they can make it very difficult to successfully implement a system even if final approval is obtained. The best way to ensure that this kind of bushwhacking won't occur is to address everyone's concerns (as best you can) as part of the approval process.

So what are some of the things we can do to show people in our organization why they should favour acquisition of a GIS?

Well, first and foremost, we have to explain what a GIS is. Because of the nature of GIS, this has to involve slide presentations, overheads, lots of visual aids. Given that we will be presenting to groups with different levels of technical expertise, not to mention levels of comprehension, I suggest that two, or even three separate presentations be assembled so that our different groups can all receive an appropriate level of information.

The kinds of things we are going to be telling them about GIS are similar to all those things we've been hearing here for the last couple of days -- the importance of attaching textual data attributes to graphics elements, the concept of layering graphical data, the capability of overlaying graphics layers to produce intersections or updates, relational databases, what is meant by the term thematic analysis and so on.

I have found that it is very important NOT to make these presentations overly technical and you might be surprised at just how simplistic it is advisable to be. You should be very careful to define all terms that might be new to your audience; look for ways in which you can relate your explanation of GIS terms and concepts to concepts that your audience is already familiar with. A good example would be the use of the term "cookie cutter" when explaining a process like clip.

Once the discussion has moved past the "what is a GIS" stage, the application of GIS techniques to your own particular situation will likely become the next topic.

- How will GIS help us?

- What will we do with GIS that we're not doing now?

My feeling is that answers to questions like these have more credence if they come from an end-user -- a divisional forester, for example, or a forest inventory manager. Now, many of you, probably most, looking at GIS are end-users, and won't face this problem, but I come from the data-processing side of my organization, so when I stand up and say "GIS will solve all our problems", I'm speaking to management on the one hand, and end-users on the other, and there's some recognition there that "our" problems really aren't my problems --I'm probably perceived as a bit of a computer jock who doesn't really have a full understanding of the forestry-related problems. I think I've successfully addressed this situation in the past by involving an end-user as a champion for GIS very early on in the process. During our last GIS evaluation, we formed a three-person team, one from my department, which is Information Services, one forest inventory manager, and one logging & forestry superintendent, who travelled to a number of different sites looking at installed systems. The written recommendations of these two end-users were invaluable, in my opinion, in convincing senior management to go ahead when the time came. It's also important to be able to refer potential users who may have concerns about how a proposed new system will affect them, to be able to refer them to their own co-workers for support and explanations.

However, talk is cheap. Many of those you'll be trying to convince just won't believe words, or slides, or overhead projections, or sworn testimonies. If at all possible, PROTOTYPE. Beg, borrow or rent a system from your vendor. Even if you're looking at a mini-computer sized system, get hold of a PC-based system for a short period. Set it up with one complete map sheet and associated data so that you can perform some real-life enquiries with some meaningful results. Then demo the system to absolutely everybody who will have the slightest contact with it. We did this at MacMillan Bloedel for three weeks prior to acquisition of our latest system and found that seeing really was believing.

The demo we showed for those three weeks went as follows:

> We showed on a screen the forest cover from a small island in Georgia Strait -- about 60 stands, in green. Then in red, we drew on the ownership boundaries, C & CG. Next, the road network came up in blue. Then we told the system to create a buffer zone around the roads at 250m, and that drew on the screen in yellow. Finally, we specified some criteria -- high volume cedar stands, say, that fell inside the road buffer-- and shaded them in. At the same time we printed out a short report giving the actual volumes broken out by ownership[1].

Most of you will have seen, in the vendor demos next door, elegant examples of thematic analysis and display. I think it is a mistake to use this degree of sophistication when doing demo's inside your organization. A simple, straightforward demo that clearly demonstrates some of the basic functionality of GIS, doesn't take very long to set up or put on, makes believers out of people who might otherwise shrug off your claims for the capabilities of a GIS.

If you are an end-user, and the thrust for a GIS is coming from you rather than from the data processing or MIS side of the company, you will still need to sell your EDP people on the benefits of your proposed system. Most companies have some kind of policy, whether or not it's formal, that requires EDP to put its stamp of approval on any system acquisitions. In many cases, this means convincing system people, with many years of experience in general business applications on an IBM mainframe, to consider the purchase, installation and support of graphics oriented hardware which will be very unfamiliar to them. Even if you intend to own and operate your own hardware, even to the extent of setting up your own data centre, I think its crucial for you to have at least the blessing of your corporate EDP group.

Again, anyone whose support you don't get can put hurdles in your way that you don't need. So, make sure you get these EDP people to look at your prototype. Have somebody available to answer their technical questions, because they're going to be more interested in how the system functions than in what it does.

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[1] Note: Slides not available at time of publication.

Basically, what you're trying to do is to make all these groups comfortable with the idea, the concept, of a GIS before you even put forward your concrete proposal. If you put in a proposal first, it seems to me you're immediately in a position of defending it -- a lot of people tend to react negatively to new ideas, and they will look for weaknesses they can criticize rather than strengths they can support. If you do the groundwork first, explain the concepts, demonstrate the functionality and display the attitude that "Well, we're looking at this to see if it's feasible in our particular application, what do you think?". Don't give the impression that your mind is made up, this is the system you're after, and you're trying to swing everybody into line behind you, then when the proposal comes along it's seen as the continuation and finalization of a familiar concept, and not only that, but everyone feels that they had a part, and offered some input, and helped you to make the decision.

Next, you might want to look at the possibility that legal reporting requirements exist which support the need for a GIS. Years ago, before MacMillan Bloedel had even the beginnings of a GIS, we used to update one quarter of our land base every year, and we got in trouble with the Securities and Exchange Commission in New York because they felt our stock prices were based on an inventory report that didn't reflect recent logging. So annual update of the entire inventory became a requirement, and was used at least partially, as justification for a new system. It's certainly worth looking at to see if something similar might apply.

I haven't said anything yet about cost benefits. As a matter of fact, I've been trying desperately to sidestep the issue. The cost benefits of a GIS in forestry applications are difficult to quantize. It would be nice if you could say, at the very least, "A GIS will produce our maps at a fraction of our current drafting costs -- Return on Investment is 35% -- Case closed". Unfortunately, for larger systems at any rate, that isn't true. The major cost benefits to be gained from a GIS are "safe" benefits -- bigger profits due to better logging plans, that sort of thing. Better decisions because of better information. I think it's important to stress the fact that the planning process, where done manually, is so time consuming that alternative plans are never developed. A GIS offers the possibility of developing numerous alternatives that can then be evaluated for highest profit, lowest cost, etc. The area in which a GIS probably offers the most power is in its ability to let you say "what if". But since you can't prove that the person making the decisions wouldn't have done as well, made as valuable a decision, it's difficult to assign a cost benefit to the capability. Perhaps the best you can say, in forestry applications at any rate, is that one good decision would pay for the system overnight. In speaking with Al Levinsohn and Larry Sugarbaker over the past two days, I've found that they both have formed the opposite opinion, that you can precisely quantize the benefits and I think Alan will be discussing this in a bit more detail tomorrow.

In any event, I believe it (the whole issue of cost benefits) would make a good subject for an open panel discussion.

In conclusion then, I'd like to summarize the suggestions I've made today:

- Identify all groups in your organization who will have contact with a GIS:
    - end-users
    - operations people
    - system support people
    - your EDP group
    - senior management, of course.
- Provide a series of seminars and presentations to explain the concepts of GIS.
- Involve an end-user to champion the idea.
- Get hold of a demo system and prototype it to all concerned parties.
- Look for any legal reporting requirements that might indicate the necessity for a GIS.
- Stress the "alternative analysis" aspect of GIS for decision-making.

PLENARY SESSION III - "JOINT VENTURES IN GIS"

Laurel McKay
Assistant Director
Land Related Information Services Group
Alberta Forestry, Lands and Wildlife

DATA SHARING IN A MULTI-USER, MULTI-AGENCY ENVIRONMENT[1]

By way of background, I am involved with Alberta's Land Related Information Systems network project or LRIS. Mr. McDougall mentioned LRIS yesterday and indicated that we were in the process of seeking the additional funds that we require to finish off what we call Phase I of a two phase project. The LRIS network is a network in a multi-user multi-agency environment developed for the sharing and exchanging of information.

LRIS is a concept that has been in existence in the provincial government for quite a few years. It's based on a premise of three central primary systems that deal with land ownership and registry, geo-positioning systems for the precise location of data and a computer mapping system with a variety of scales, providing a basic referencing system that you build other information systems on or build in relationship to. The other systems are referred to as "secondary systems" or thematic systems. The majority of the information and over the long term the real payback in the system is in the thematic systems.

The Phase I deals with the network subsystems which are the referencing and standard systems that are required to be put in place in order that you can tie all the systems together.

My main talk today deals with some of the specific things about using geographic information and using that in conjunction with the analysis tools which are GIS tools, and what special considerations that kind of information imposes on you if you wish to use it in a situation where you share information between users.

I wish to mention a couple of assumptions that I think are important. We are talking about a computer environment and a lot of these applications apply even if you are working in a paper environment, but often the payback in sharing information isn't there in a paper environment. It is in a computer environment and some people are more inclined to make allowances in order that they can share information. Secondly, sharing is good, as

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[1] Note: Paper transcribed and edited from tape.

Larry Sugarbaker noted yesterday, data loading and conversion is the most expensive part of developing a system and if you can use some data that somebody else has gone through that process of capturing and converting, then you are going to save yourself some money. Hence, you want to be in a situation where only one person is collecting a piece of information but a lot of people are using it.

If you are sharing information, the chances are that your access to information is faster and so your ability to use the information is faster, rather than spending a lot of time doing conversions, collecting, you can be using the data in analysis.

Thirdly, sharing means a network. Our long term goal is to have an on line system where information is passed between different users . In the short term, it is probably something simple like a tape transfer, but you still have to make the same considerations for standardizing your data in order to share it.

In my presentation, I will use the word "you" a lot and "you" refers to the community that you are interested in sharing data between. For the provincial government in the LRIS network, it means provincial government departments and agencies, the private sector, municipal governments, the public, and that's over the long term. For you people here, your sense of community may be different, it may be the company that you work for, it may be you as a community of foresters that have an interest in sharing information among yourselves, you may have an interest in sharing information with the government also. So community is that group among which you are interested in sharing information.

The last thing that's probably important here is that we are talking about tabular and spatial data. If we are dealing with GIS, you have the two components. Tabular data follows traditional data processing, hardware and software and methods; the records are information about something, it's information about a lease or information about a forest stand or information about an ownership parcel. You select records out of the system based on some sort of criteria so all leases that were entered into in 1986 and the output is usually in some sort of a report. The spatial data is handled in a non-traditional way, at least in terms of the computing environment, and that means that a spatial component is part of it, it is information about somewhere, the selection is by location as opposed to the other criteria, and the output is usually a graphic display that looks like a map. The key thing here is that there is a relationship between your tabular information (between your somethings and your somewheres). So for every something you know something about where it's located and vice versa.

Within a GIS, there are two different ways of going at the data. One is you start with the information and then you look at a picture or a map of where that information ends up or secondly, you start with your map and then you get a report about the information that goes with it. So we are assuming that you want to share data, you are going to have to come to some agreement as a community on how that data is going to be collected and stored, how it's going to be maintained and those are your standards, and you require traditional computer standards about maintaining data, but you also require some standards that go along with the geographic or the spatial part of the data.

Within the design approach that we are taking in Alberta's LRIS network, geography is our common denominator and we are using that as the basis on which we are going to develop other systems. Because the spatial information is the most complicated and the most difficult of the information to handle and it's the most troublesome when it doesn't fit, and by not fitting, you have probably all brought together maps that were made by different agencies and laid them on top of each other and had a lot of problems because the lines didn't all match up perfectly and caused you to have to go in and fix the data.

The easiest way to have it fit is to have everybody work from the same set of spatial data and build their relationships with that spatial data in their tabular systems. As a beginning, you may want to find, as a community, a common base map that you can all work from. Hence, you have to come to some common agreement on what that common base map will look like. In selecting the data elements that go into your common base map, you look for stability - you don't want information that is very volatile, that it changes very often because that impacts other people. You want to look for what are the common geography elements, what are the basic units that you as a user community are using and look how you are going to have to handle updates. You may want a land survey fabric and the geo-positioning or coordinating information that goes with it, you may want hydrography, transportation system, elevation information and for some people that would be enough for a base map. If you are with a company, you might include your lease boundaries or if you are a forest management agency, you might include your forest coverage polygons.

Once you come to some agreement on your base map, you can start deriving the standards that will allow you to manage that information in a standard data processing methodology. This becomes your corporate data base that everybody else is relating their information to and you've come to some agreements on the standards for that data and who is going to collect it and who is going to maintain it and how do people access it and how do they use it? Then each of your user groups which collect their own information which is related to the data base can come to some agreement on how the other spatial information is going to be related to the base map and what the standards are to be used.

Part of the community may be very concerned with soils information or wildlife habitats because they're doing overall environmental management and there is a relationship between those coverages to the base map and that community as a whole can come to their own agreements on standards and can decide who collects the information, who maintains it, who can access it, and who updates it.

In the provincial government, for the LRIS network, our primary focus, at least for a starting point, is a parcel fabric because the parcel fabric is very stable. We have a land titles system that will build a very close relationship with the parcel fabric and we have a Crown lands system which manages information about leases and dispositions. There will be a close relationship between it and the parcel fabric. What we are going to have then is information in that spatial database that allows us to draw the boundaries for a parcel and it's going to have an identifying number on it. Then the people in Municipal Affairs when they develop assessments systems, will use the same identifier that Land Titles will use in their system, and the Planning Board uses that identifier in that system. So what you have then, is the key that fits through all the systems.

This is all assuming that there are some benefits to be gained by sharing information among users. The first benefit is that updates to data don't become a major problem - this is if you are sharing it following this corporate philosophy. One of the situations that you can get into if you are sharing digital maps as opposed to sharing within a GIS environment is that the next time you update the map, the guy down the road that has overlaid his information on that map, has to go back in and make a lot of adjustments to his data to allow it to fit again. People are using the most current information possible so the next time they go in and grab from that corporate base (the spatial information), you know that they are working on the base with the best available map information.

You might find as professionals, that people are using more information, more 'tertiary information' that in a modelling or analysis situation they wouldn't have used before because it was so difficult to bring it in and incorporate it with their data and clean it up. If it comes in and it fits nicely, they might start including some of that tertiary information in their analysis.

Lastly, it means that you are going to have more dollars available for doing your professional activities of analysis and decision making and long range planning, since you are not spending those dollars on new data collection, data conversion and data entry.

To summarize, I would like to re-emphasize that one of the reasons that we are involved is that information is in fact a resource and it's coming to be seen more and more by all kinds of people that information is a resource and it can be a renewable resource and more specifically than that, it's a resource that if one person consumes it, it's still there for another person to consume.

Gerry M. Coen and Wayne W. Pettapiece
Agriculture Canada Soil Survey, LRRC
Edmonton

THE NEED FOR STANDARDS IN SOIL DATABASES: A NATIONAL PERSPECTIVE

ABSTRACT. Efficiencies associated with electronic management of databases will only be realized through the adoption of standards for both EDP procedures and raw data organization. Efficient electronic data transfer from one discipline or agency to another is a prerequisite for optimum use of GIS databases. Federal and provincial soil surveys are actively promoting the development of appropriate standards. The Canadian Soil Information System has developed a set of standards and guidelines that will be used in preparing digitized soil survey information suitable for the soils component of a GIS. For Alberta, the Soil Information Database for Management and Planning provides, in raster format, spatial soils data according to defined standards. The challenge remains to select the most appropriate standards for the largest number of data users.

INTRODUCTION

A Geo-information System (GIS) provides no more and frequently less data than the raw dataset from which it was compiled. It usually allows the generation of derivative data. No GIS analyses can be undertaken without the preparation of a very specific set of instructions to the computer (algorithms), so in fact, the analytical procedures must first be developed manually. It is frequently necessary to be more specific about the procedures written into computer algorithms than if the analysis was done manually (with the consequent questioning inherent in a manual procedure).

The power of GIS is in the ability to manipulate vast amounts of data quickly and accurately although perhaps indiscriminately. To take advantage of the efficiencies in electronic data manipulation, it is imperative that precise standards and procedures are established and adhered to so that data can be electronically transferred from one agency or discipline to another with a minimum of manual intervention.

THE NATURE OF STANDARDS

The more standards that can be adopted by both suppliers and users of GIS, the more efficient data exchange will become. The development of standards is largely a technical process but their adoption can be strongly influenced by an organization's bias or an agency's policies as pointed out by several papers at the Spring Conference of the Alberta Chapter of URISA (6). Standards need to be developed for electronic data management and for the acquisition and organization of the thematic and cartographic data.

Electronic data management standards

Exchanging data between differing kinds of hardware can result in inefficiencies if not incompatibilities. There are relatively few major incompatibilities between hardware types that have not been solved or circumvented, so I do not expect hardware differences to remain much of an impediment to efficient data transfer (12).

The kind of software used to store and manage GIS information can greatly influence the ability of agencies to share databases. Standards for exchange of databases, raster data and line segment data are being developed. Software translation procedures are also rapidly improving our ability to move GIS information from one agency to another (2, 11, 12) but there is still much opportunity to improve the ease of data transfer. Since the significant variations in hardware and software between agencies is relatively finite and small transfer problems between agencies once solved should not reappear, I feel we are well on the way to overcoming many of the electronic data processing restrictions to efficient data transfer.

Physical data standards

The conventions we use to collect and organize the data we want to process in a GIS environment can profoundly control the efficiency with which data sets can be merged and manipulated. Natural resource data is normally fitted to a base map. If, for example, soils data is fitted to a 1:50,000 NTS base map and forest cover data is fitted to the 1:20,000 Alberta digital base map considerable effort may be required to solve incompatibility problems between the base maps. Boundaries of water bodies at 1:20,000 scale can be shown with more precision than at a 1:50,000 scale and will therefore not be coincident even if the scale is electronically altered to match. Both soil and forest cover have boundaries coincident with water bodies on their respective base maps. Therefore, even if the base map "layer" is separated from the resource "layer", there will be meaningless "slivers" produced when we try to merge the soils and forest cover information. These "slivers" must be eliminated manually, or by a custom algorithm before data analyses can proceed. A significant gain in efficiency can be realized if both (all) resource information can be fitted to the same base map.

Adherence to agreed upon standards within a given resource sector will also greatly improve efficiencies of GIS activities. Suppose we wish to use GIS to evaluate topography in southern Alberta. Data will be needed from both the Soil Survey of the Milk River Sheet (14) and the Soil Survey of the County of Warner, Alberta (8). The topographic conventions used in the two map areas are not the same (Table 1). The lack of a standard presentation of topography requires data translation rather than simple data transfer. Note as well that in this situation, the final combined GIS data manipulation can use a maximum of 4 topographic classes.

TABLE 1

TOPOGRAPHIC CONVENTIONS ARE NOT NECESSARILY IDENTICAL IN ALL AREAS

TOPOGRAPHIC CONVENTION	
Milk River	Warner
Level and undulating	flat or level
gently rolling	nearly level
rolling	very gently slopes
hilly	gentle slope
	moderate slopes
	strong slopes

MECHANISMS FOR STANDARDIZATION

A major contribution to the standardization of soils data is provided through the process of correlation. Correlation is accomplished through reference to published standards such as The Canadian System of Soil Classification (1), the Canadian Soil Information System Manual for Describing Soils in the Field (4), A soil Mapping System for Canada: Revised (5) and The Soil Survey Handbook (3). Development of a standard set of soil series definitions contributes to our ability to use and exchange data either manually or electronically (9). Documented standards for soil survey data and procedures have facilitated our attempts to organize our data for GIS manipulation.

At the provincial level, we have prepared SIDMAP (7) a raster format database providing information on all of the province covered by reconnaissance soil surveys (Fig.1). The grid cells are coincident with the 1/4 sections of the Alberta Legal Land Survey. Soil and Land attributes such as subgroup or series classification, topographic data, agroclimatic zone, CLI - Agricultural ratings and a summary of soil and site properties were coded for each 1/4 section. Because the soil survey data was assimilated over a period of over 40 years and at scales varying from 1:190,000 to 1:50,000, it was necessary to standardize the data

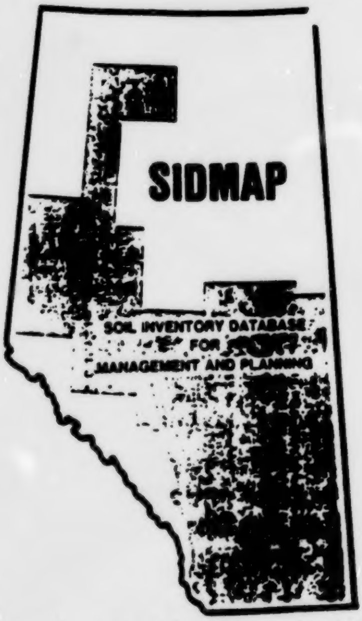

Fig. 1. Portion of Alberta covered by the Soil Inventory Database

for studies that covered a large portion of the province. A soil names file for Alberta was prepared providing the definitions for all of the soil names in Alberta. Then the distribution of soils in each 1/4 section was revised using the standard names in the Alberta Soil Names File. The size of the grid cell suggests the application of SIDMAP should be restricted to scales of smaller than 1:250,000 or at Survey Intensity Level 4. As a GIS tool SIDMAP has proven to be able to efficiently link soil survey data to a wealth of agriculture related data on over 550,000 quarter sections in Alberta.

At the national level, the Land Resource Research Centre in Ottawa, after several years of developing an in-house system, has chosen to use ARC/INFO as a GIS processing software. For reconnaissance maps digitized into ARC/INFO, we have adopted a set of 5 attribute files to link data to the map polygons. The following names can be addressed by the relational databases:

Project File	-	provides documentation specific to each soil survey report such as publication date, analytical methods, reliability estimates.
Polygon File	-	links map polygons to the map units as defined in the map legend. Provides area and perimeter of the polygon.
Soil Map Unit File	-	provides a description of the different kinds of soils that are associated with the map unit symbol. A map unit will normally be comprised of up to 3 soil series, slope classes and stoniness classes.
Soil Names File	-	provides a description of site attributes of soil series including classification, mode of deposition of the parent material, drainage class, and depth to water table.
Soil Layer File	-	provides a limited description of morphological, physical and chemical attributes of each soil series in the Soil Names File.

The Soil Names File for the National files is being prepared by updating the Provincial Soil Names File. Standardization we undertook in preparing SIDMAP is proving to be very helpful.

With this fairly well defined data structure and a uniform standard of physical data recognition, we anticipate being able to transfer data from national to provincial units with a minimum of translation. Because the data being entered into our GIS was assimilated over a period of at least 30 years, it was not uniform to start with. We are expending considerable effort to bring all of the data to a consistent standard but it is not all equally reliable so it will still be necessary to examine the appropriateness of the data for given users. Alberta data resident in CanSIS-ARC/INFO has been prepared by the Terrain Sciences Division of the Alberta Research Council and The Alberta Soil Survey Unit of The Land Resource Research Institute which, together, make up The Alberta Soil Survey. The area digitized to date is shown in Fig. 2.

Also at the national level, we are preparing Generalized Soil Landscape Maps at 1:1 Million scale for all of Canada. These maps all have standard software structure and data files.

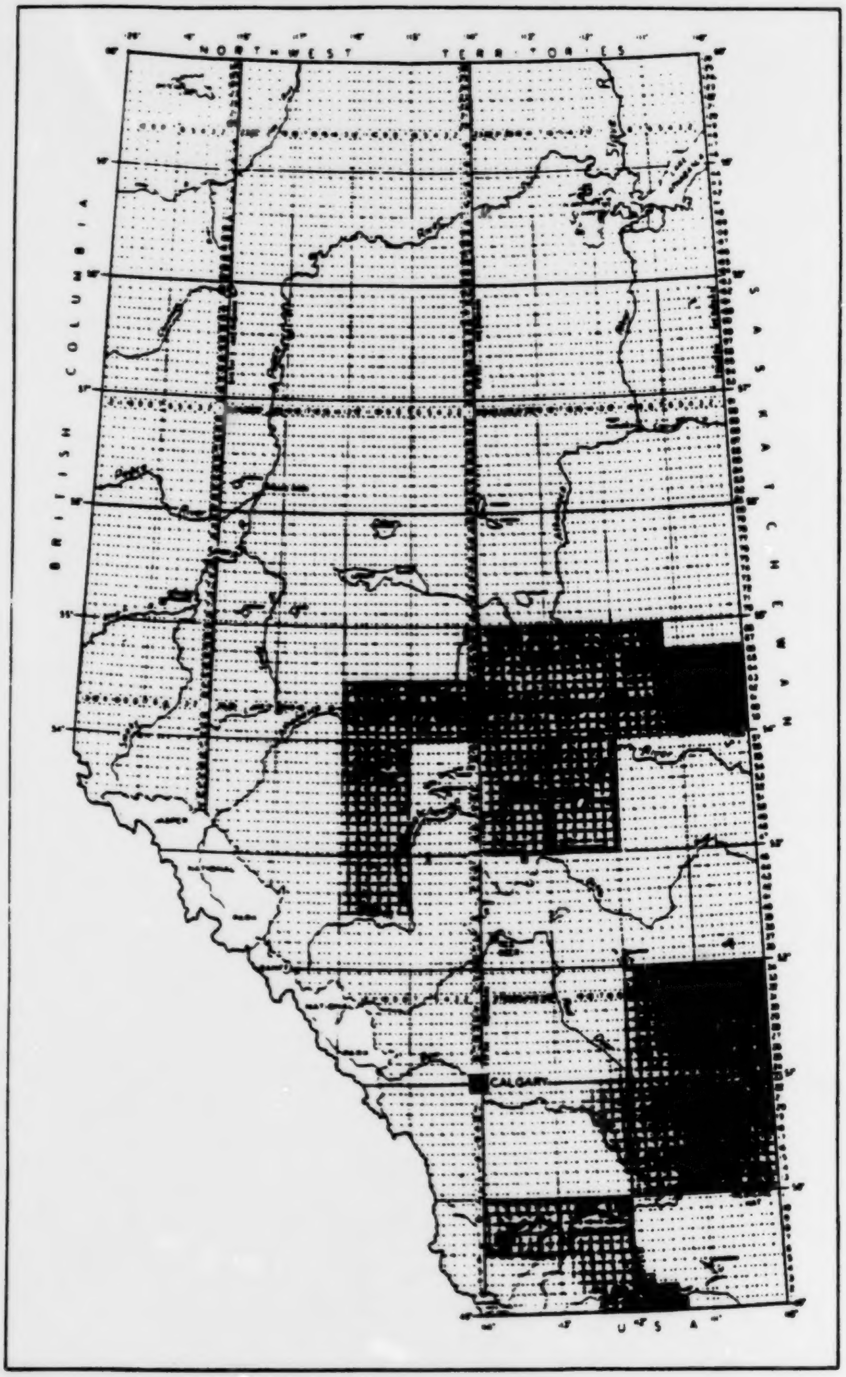
NORTHWEST TERRITORIES
BRITISH COLUMBIA
SASKATCHEWAN
U.S.A.
CALGARY

Fig. 2. The portion of alberta covered by the digitized database in the Canadian Soil Information System.

We have been able to transfer a copy of this map to Alberta Forestry, Lands and Wildlife, Information Services where after some manipulation it has been useful in management studies (N.B. Ferguson, personal communication).

OBSERVATIONS REGARDING DATA EXCHANGE

The organization and nature of data in any electronic environment should be meticulously documented before efficient data exchange can take place. This documentation allows both the owner and receiver of the data manipulation that must take place during the exchange. It is necessary to determine, as well, which party must undertake the data manipulations (10).

Documentation should allow a prospective receiver of the data to evaluation whether the data he receives will be sufficiently useful to make the transfer worthwhile. There may be an elaborate data structure but many missing values, making the data of limited usefulness to a prospective user. It is also extremely important that the appropriate scale of the digitized data be designated and a measure of the reliability of the associated database provided. If an agency has data that will likely be in demand by other agencies, it might be most efficient to provide prospective users with a "shopping list" of likely data packages to identify what is available and allow them to choose the closest match for their purpose. In many cases, I expect this procedure will lead to networks of shared data. As shared data becomes more commonplace, I expect we will need to set up user groups with fairly specific procedures in place to identify and solve exchange problems.

SUMMARY

We are beginning to appreciate the kinds of standards that are necessary to allow efficient transfer of electronic data from site to site or agency to agency. Not all data has been collected in a standard manner so we must expect some difficulties in preparing that kind of data for sharing. Databases are a very powerful tool for managers and decision makers (13). Therefore, sharing databases involves commitments and responsibilities on the part of all parties. Solution of the technical problems will not necessarily promote the sharing of data. For the inventory community, the challenge remains to select the most appropriate standards for the largest number of data users. Then, when it is advantageous for managers of agencies to exchange data, it can be efficiently undertaken.

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David A. Nystrom
Chief of the Office of
Geographic & Cartographic Research
National Mapping Division
U.S. Geological Survey

CO-OPERATIVE EFFORTS IN GIS FOR THE UNITED STATES GEOLOGICAL SURVEY[1]

Thank you, Bas. It's nice to be here. I think I have put too many slides[2] in the slide projector so I am going to drop my jokes and get right to a story that I'd like to tell because, in 20 minutes, it's going to be hard to go through the slides before I get the 'hook' from Bas, so we'll get started.

This first slide is really kind of an important slide, because many people who come to the Geological Survey, think the big problem with GIS is the hardware and software issues. You have heard today and I'm sure you've heard before that people who have been evaluating hardware and software know that the real problems are in building the data base. In our determination, the most expensive, time-consuming, the hardest part of the process, and it's worth spending a lot of time right now looking at format, content, accuracy, data exchange issues, and some of our top scientists are working on that issue.

We do have in three research laboratories all that hardware and software you see listed there and then some, and you saw the Intergraph slides this morning - we just recently acquired the new Intergraph Interview 340. We have the architectural and three-dimensional software and we've just started an urban planning project in Washington D.C. that's really going to be exciting.

You see a name of a hardware computer there called PIXAR. That was delivered just last month - we're all excited about that. You heard "speeds" this morning mentioned - that's a 120 mip computer, it has 96 megabytes main memory. We can scan photographs or take satellite information and feed it into that computer and bring it up on a very high resolution screen and zoom in on part of the image in a real time move-around as you're zoomed in. We think it's going to give a lot of push to trying to merge the Raster and Vector datasets and iron out some of those problems.

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[1] Note: Paper transcribed and edited from tape.

[2] Note: The series of slides used in this presentation were not available at time of publication.

You heard from Bas, why USGS is so involved in GIS right now, in fact, those committees were established in the early '80's to try to avoid duplication of digitizing and if you go to one of those committee meetings now you'd think that you're not in a digital cartography meetings but a GIS meeting - they have really evolved into all the GIS issues.

A summary was done this last year by that Federal Committee on just who is doing what with GIS in the federal government, and 50 agencies were contacted, 31 responded, which I guess for government work is pretty good, 28 of the 31 either use or intend to use GIS, 7 have a written policy which is important (and I'll touch on that again). The projected range of expenditure is between $26 and 46 million and $48 to $69 million and our own Forest Services gave me a document on the status of their evaluation of GIS and in the '90's, they're projecting to be spending between $17 and $20 million a year on GIS.

Another document that I brought is a "Federal Digital Cartography Newsletter" - it's a real nice communication mechanism - it's free and I know some people have told me they're already on the mailing list, but if you want some of these other handouts, this would also be the place to write and ask for some of the other documents.

A brand new document that just went out for review last week from the Federal Committee - "The Technology Exchange Work Group" and a Dr. Steve Gupler who is on my staff is the chairman - put out a rather thick volume outlining the process for evaluating geographic information systems. It has functional components of GIS in here, it has a glossary which is kind of important, and it even has a process for bench marking the technology. Again, this is out for review, if you get a copy of it and you read it seriously, I am sure Steve Gupler would appreciate any comments that anybody here has on the document.

I mentioned that only seven agencies had a written policy. This is so important because even within the Geological Survey that started some years ago with GIS, we were really "spinning our wheels" until the director wrote a written policy statement and made that known to the divisions because then middle management understood that the director was serious about it and it had a top/down management approach. If you really want to get started, it is very important to get a written policy that people understand.

There are four divisions actively using GIS in the U.S. Geological Survey. Our Information Systems Division was a computer support division and they saw a role to help the program divisions and they were the ones that immediately saw the need to try to look at micro-computers and now, in our GIS labs, we're spending a lot of time trying to take complex datasets and complex applications and get them on micros because to really get them in the hands of the scientist, we need to get off the mainframe and the big mini-computers and get down to the micros.

They also started the money coming in to look at artificial intelligence knowledge-based GIS systems, which we think is the next step. We are starting to make ties right now to our existing GIS systems and I would be happy to talk to anybody about what we're doing in that field.

The Geologic Division, for years, has been using the technology to make computer maps, but very little of the analyzing with other datasets, and that has changed so much in the last year. They want soils data, they want water, they want everything and they are really knocking on the door at our GIS labs. right now, trying to get additional capability.

This is a project that was just completed in San Mateo County, south of San Francisco - 'landslide predictability'. The County was so impressed with the results that they have incorporated the results of that GIS project into the zoning ordinance for that county.

Our Water Resource Division is by far the biggest user of GIS in survey and this is just one division - they bench marked the technology, they chose the ARC/INFO GIS and they have over 40 installations now around the country with GIS and hardware using a telecommunications network to talk to each other and to transfer datasets. They're doing many national GIS kinds of applications down to very specific project level applications - this one, in conjunction with our Environmental Protection Agency, is looking at potential hazardous waste sites in the Norfolk area, part of the Chesapeake Bay project and we're making some really interesting progress on that project.

The National Mapping Division, though not a big user of GIS, is really the research and development arm of Survey's GIS work, looking at, the database content, accuracy and standards. I brought a couple of copies of "The American Cartographer", as a matter of fact the book is the proposed standard for digital cartographic data and it's out for review right now - I could have brought more copies of this but again, if you get that newsletter, you ask them for a copy - I am sure they'd make that available.

We're doing a lot of evaluating of systems. As people come to us and buy our digital data, be it geologic data, water data, transportation data, they say, "Hey, we're going to buy 'x' hardware system and 'y' software system, are we going to be able to use your data?" That's one of the reasons, we are acquiring all kinds of hardware and software in key locations across the country so we can talk to the users of our data. Technical assistance to the local user all the way up to the international level and co-operative applications projects is really the "proof of the pudding". Nobody understands the standards issues, the exchange issues, the accuracy issues until you sit down and do a co-operative project and we're doing a lot of them, in fact, our director right now is making a $1 million available every year to have people submit co-operative projects and to be a winner, you've got to get all four divisions in Survey working on it. He likes to get a state involved, he likes to get other federal agencies involved and some really interesting results are coming out of that work.

I threw this in - one big thing that we're working on right now and have just completed is the 1:100,000 transportation and hydrography dataset for the United States. That will be the basemap for the 1990 census maps and it's going to be a tremendous GIS database because census is going to add to our transportation data all the economic data, street addresses, names of the streets and the urban planning networking capabilities are going to be tremendous. Our postal service just called, they are interested in getting GIS hardware and software, but they're more interested in when is that database going to be available because they can't do their resource allocation and networking work that they want to do, until they can get a hold of that national dataset.

I mentioned three labs. across the country that were developing - these are multi-divisional, all four divisions are working in it. I have some flyers again if anybody wants additional detail as to what's going on in those labs, the address and the phone numbers are on the back of these flyers.

Just a quick run-through of some of the stuff in the labs. We've got about seven digitizing tables in our lab. We try to get available digital data, but we have to digitize many times to get custom products and we have just installed a new Tektronix scanner for thematic geologic work that we're being requested to do. Lots of analysis, this being a Vector system, we're doing quite a bit of image processing work. This is a system called MIPS - Mini Image Processing, which we developed and it's actually taking image processing software and mapping out the sea floor. They're taking sonar data towed behind a ship, but using the capabilities of the image processing software to map out the exclusive economic zone.

While we're trying to move towards micro-computers, we'll still have to rely on the mini-computers for regional and national data analysis. This room, in the last two weeks, has changed - we now have a great big PRIME computer that has just been installed. We do a lot of custom output products - this is one of the big 42 inch colour electrostatic plotters. It does really nice GIS-type work, that's about an 8 foot map and you can do different scale products all on the one map. I mentioned technical assistance from the local all the way up the international level - two of my guys just got back from China, they were there for six weeks and we now have two Chinese in our lab. working for six weeks.

Many demonstrations - the word got around that we have these labs. and the director wanted people to come see what's going on, but we had to just hire a person full time to give demonstrators. He is a training demonstration person and the demonstrations happen almost every day right now. We have had about 2,000 people come through just the Virginia lab. in the last year.

The co-operative projects - again, those are the "proof of the pudding". These are some of the co-operative projects, again because we are on the Federal Committee, we've been asked by the Environmental Protection Agency, the Bureau of Mines, the Bureau of Land Management, Fish and Wildlife Services to display results of co-operative projects with them. We have just started one with the National Forest Service in Oregon on their National Forest and it will be about a year before we can show some really good results on that. We just started one with Fish and Wildlife Service in Northern Alaska on the Arctic National Wildlife Refuge to plug in our geologic and resource data with their Fish and Wildlife Service data and it's going to be almost like an interactive environmental impact statement process to plug in real data and look at potential problem areas on the caribou and polar bears, etc., and try to figure out mitigation measures.

Just a couple quick slides - This is a real good example of what we do on co-operative projects. The State of Connecticut came to us and said, "We want to evaluate the technology." We picked a real small two-quad area where they had a lot of data and said, "O.K., let's do it, just on that one area.". This is what we digitized just for that one pilot project. We have actually about 35 datasets that we digitized, different scale data, USGS data, census data, soil conservation service data, state data and use the system to merge it all together and answer real natural resource planning questions. That's another part of the co-operative application process is when you come in, it's not going to be a hypothetical problem, you got to come in with a real problem and we'll try to address it using the technology.

Just three datasets on that Quad and I'll zoom in just to show the level of detail on these pilot projects. Even the land use polygons there, it not only says in yellow that it's residential but it even has attributes like the percentage of impervious surface, the forest types of percentage of crown cover so they can use that land use data in their water planning for the State of Connecticut.

The last thing I'm going to touch on is something that we're real excited about, our Program Management people came to us about a year ago in the research lab. and said, "We can't query our national databases and can you figure out a way, using GIS, to do that?". We spent about a year evaluating different systems on mini-computers and finally one of my guys said he was ready to give a demonstration. I went down and asked in Virginia, how many Quads have transportation and hydrography complete and he typed that into the system and said "Well, let's go to lunch, it'll take about 45 minutes to get an answer", and I said, "That's not acceptable". Right after that, we had a vendor come in and give a demonstration, which is another thing we encourage in the GIS labs. - is vendors to come in and show hardware and software. We try to do it at lunch time and put up flyers in the building and invite people to come down and see the vendor demonstrations. The TYDAC Company from Canada came down and gave a demonstration at lunch and I sat in the back of the room and they've got a Quad III data structure and I said, "Now wait a minute, that's what is missing, I think if we gave them our data, I bet they could plug it in to that system and we could query our databases.". So I gave the TYDAC fellow a tape with all 54,000 Quads in the United States that had the status of our data. They came back in one week and sat down and had our Program Management people ask questions of the databases and hard questions, and they typed in and in a matter of seconds, brought up the answer to every single question that was asked.

This is the status of hydrography, transportation, number of layers in process, number of completed layers and percent complete so that you can get into economic analysis-type work, yes - you can zoom in and even further, you can get right down, even to the Quad level, you can query each Quad and get all the information on the Quad as to the status of what data is available. We're going beyond National Mapping Division's data and plug in Geologic Division's data. All digital data will be able to query by Quad around the country. We're going make a mass buy of this software, not for some of the GIS capabilities but for program management, economic analysis and we're also going to put it in our sales stores, because right now if somebody walks in off the street and says, "I'm going to do a GIS project on these four quads right here, what digital data is available.", if the store manager knows how to find out, it usually takes him about two weeks to get an answer. We think that's in the stores now, that if somebody walks in off the street, they'll be able to type in what is available, give the person a colour printout of exactly what's available and how to order that data. So it's going to be a real nice tool, again using GIS, but for a much different reason than a lot of our other applications.

I think I'll just stop right there. Thank you very much.

QUESTIONS & ANSWERS

ALLAN LEVINSOHN: I would like to ask Mr. Nystrom, approximately what is your annual budget?

DAVID NYSTROM: It's a real good question and I'm embarrassed to tell you but I'm going to tell you. GIS in the U.S. Geological Survey has been looked on in the past as the cost of doing business and we really assessed program activities, project activities for the research and development of GIS. It has grown to the point where I've hired an entire branch in this last year -a lab. director and systems programmer, etc. that we can't do that any longer and I've finally convinced our director that it's time to either reprogram or ask for more money and I think we've got some receptive people in the Department of the Interior, whether or not they can sell it with the Office Management budget, I am not sure.

Our budget right now for actually five facilities, one in Western Virginia, one in Denver, one in Mennlo Park, California - a research facility, the Aerostate Centre in Sioux Falls, South Dakota that's doing a lot of GIS work, and a multi-divisional lab. in Anchorage, Alaska - our budget is $1.7 million. I did a rundown on what National Mapping Division spent this year in just three of those labs., the rest in Denver Mennlo Park lab., and we spent $4 million. So I am putting together a budget initiative that is going to go down to Main Interior, we are asking for a big increase in dollars and I think we can justify it. The economic situation right now in Congress and in the Office Management budget, I am not going to bet on that they make it in, but at least they'll know and we can document and show them the dollars we're spending, but we're asking for a $12 million increase in 1990.

AUDIENCE: Mr. Nystrom, information that is available through your group and sharing of that information, do people pay for the information that they would get from you people?

DAVID NYSTROM: Another good question. Part of the National Mapping Division's budget is based on sales of data and that's getting pretty complicated with GIS, and in fact, what's now happening - a good example is a new initiative with the Forest Service. They really wanted our digital elevation model data that was not available in National Forest so they said they were going to go out and contract to get that data but that they would do it to our format when the contractor completed that, they could give us that data and we would exchange the data from another Quad with them. So that has started. The State of North Carolina didn't like the projection on when the data was going to be ready, so they said, "How about if we become a contractor for USGS and we will turn digital data into you, you can look at it and let us know where edits have to be made and send it back down and then we'll have the data, you'll pay us just like a contractor, but you'll be building your national database. So there are a lot of really interesting new things starting and that North Carolina example seems to be working pretty good.

However, Bureau of Land Management, which has some data that we want, we are telling them that you have to pay for our data that is our policy, that policy is starting to break down, because there are datasets that we want and they're willing to give us the data, so I think when both agencies have something to gain, you're going to see sharing of data across the board.

BAS DELANEY: I'd like to ask the other panelists if there is such a policy in terms of access to information, and the cost of access to that information.

LAUREL McKAY: There is a policy in Alberta called "Exchange of Digital Land Information ", I think, that has been accepted by Cabinet and it was proposed by the LRIS Steering Committee. The way the policy reads now each department or each minister gets to decide what information is available to the public, how it's made available and whatever price goes with that data, what restrictions. Each of the departments that are involved has been requested to respond to the Steering Committee. I think about seven or eight of them have now responded and when those are all together, it's going to be tabulated and it will be published as to what information is being made available.

DAVID NYSTROM: I was going to make one point in my presentation and I just remembered it. There were some questions about economic benefits and I was in a meeting last year with the Office Management and Budget and most of the key GIS players in the federal government, and the Office Management and Budget asked the question, "Do you people think GIS is cost beneficial?". We went around the table and asked each agency and every single agency said, "Of course!". Most of them even gave a percentage of what they thought the benefit was, and then it got back to the guy from Office Management and Budget and he said, "That's great, I would like to see your reports and your documentations.". So he went around the table again and not one agency had a report or documentation to back up the statements, even the people who said that they knew the percentage.

If we are going to tell people that its cost beneficial, we had better start taking some pilot projects and look at what it would have cost us in a manual way and what it cost us in an automated way, so we can back up some of those statements. And really, the technology is so new that most of the agencies just haven't done that and I am trying in U.S. Geological Survey, to take a Geologic project, a Water Resource Division project, a National Mapping Division project and document what we think the savings are going to be so we can show that to OMB, especially when we are going to them for a big new increase in funding.

GERRY COEN: I am not sure whether Laurel's comment will tell you how to deal with the SIDMAP database that I talk about, which is in the Alberta government computer. Nationally, the soils group that I am attached to doesn't have any well-defined policy on data exchange out of our automated databases. We take the position that the data that's there, is paid for by the country, it's their data, so if you walk in with a tape, we'll copy it to a tape and let you have it. One of the problems we have with that is that you can have any data that we feel is quality controlled -that has some checking on it. We sometimes get data that we haven't done our housekeeping on, haven't done our quality control on and are not prepared to say that represents what we think we want to pass out.

So we do have permission, I guess from our agencies to go ahead and deliver data in a format that we corrected. We don't have budgets or haven't developed user friendly ways of getting data from our datasets to transfer it across to other agencies in a format that they can best work with. I hope that we are going to work in that direction because I think that if we are going to have to get a committee together which looks at trading data and says, "What is that you have to do to the data before I can use it and what is my responsibility to do with the data once I get it?". We have to make those kind of breaks and that's the only way we are going to get at efficient data transfer in standards that make sense.

AUDIENCE: I would like to ask of the three speakers, if they would share with us some of the attitudes that they have had to deal with in the past in getting GIS implemented.

DAVID NYSTROM: I'd be happy to start. My biggest problem with attitudes to GIS is really my own bosses. The National Mapping Division, historically produced paper maps, your topo maps and data in a print media and all of a sudden, the National Mapping Division is being asked to provide custom digitizing analysis output products, some of those output products don't even get reviewed, which is a "no-no", and I am having a real hard time convincing my own bosses that this is what the National Mapping Division should be moving into, even though he is being told by the director of the Department of the Interior that that's what they want. He grew out of a product or organization and some of the top people there are really having trouble moving into a service and the technical assistance - it's a service orientation. So that's the big attitude problem I've run into in my shop.

GERRY COEN: We started putting together a digital data base about 1972 and at that time, someone got up and said, "I've got the thing that will solve all your problems.". We're still waiting for him to deliver. So the attitudes that we have to deal with are ones on the part of researchers of skepticism which is inherent in a dataset. I think we also have to deal with the attitudes that you just mentioned about need for traditional dataset and we have to keep these things parallel, so there is a whole lot of growing that needs to take place on both sides. We have to admit what it is we can do right now, we can project if we want and say what we should be able to do, then we have to admit what is possible now and we have to then be quite honest and trade back and forth what we need versus what we like and what it is that other people need to serve their purposes and how important is that need? Paper copies and digital copies are the same information but they don't serve the same clients and how you service your client is with a change depending on which medium you use. These are whole changes in structures. I think we are seeing some recognition of those changes which have to come into place, recognizing that we're ready to make structural changes in our organizations and to let those things happen.

LAUREL McKAY: We don't develop GIS systems so I am not sure how to answer that. I guess the one thing that needs to be important is that when we are dealing with people that are developing GISs to get them to see not just the automating of what they are doing right now but to see what the advantages there are and the new tools they're going to be using, what new things they're going to be able to do and also get them to look forward into the future so that whatever they develop, they'll be able to use it for the business they're going to be in in five years.

PLENARY SESSION IV - "SELECTING THE RIGHT SYSTEM"

R. H. Lamont
Chief, Forest Management
Manitoba Natural Resources

AVOIDING SURPRISES IN SELECTING AND SETTING UP A GEOGRAPHIC INFORMATION SYSTEM

ABSTRACT. During the period September, 1984 to December, 1984, the Manitoba Forestry Branch assembled a complete list of requirements for a Forestry Geographic Information System based on known and expected needs of Forestry and related resource disciplines in the Province. Resulting information was used to structure a "Request for Proposal" for system vendor response. The approach allowed proposals to be evaluated in a uniform manner upon receipt. The procedure aided the system selection process and allowed for sequential site planning, construction, installation and User Training to be completed in August, 1985.

The selection and setting up of the right Geographic Information System is not a simple task in today's complex resource management situation. Differing views of data base importance, area priority and scheduling options can adversely impact the selection process leading to interesting situations.

The Manitoba Forestry Branch was faced with the selection of a Forestry Geographic Information System as a component of the Canada/Manitoba Forest Renewal Agreement signed in March, 1984. The system was to provide for Forest Management analysis and decision making opportunities for the Province's Forest Resources. The funding arrangements defined that the cost of selection, installation, maintenance, staffing and expansion of the system were a Manitoba Forestry Branch responsibility. The amount available for the system purchase and operating costs were defined so that the total expended over the 5 year agreement period would equal a 50/50 shared cost arrangement. With these guidelines, the program was presented to the Forestry Branch for implementation.

SELECTING THE RIGHT SYSTEM

I suspect that there is, as yet, no single "Right" Geographic Information System for all agencies. The system selected depends on an agency's user needs, present system components in place, the extent of the information base to be entered into the system and the nature of the data analysis requirements in the future.

In September 1984, the Forestry Branch established a review committee to carry out a search for suitable system suppliers, develop a detailed list of user needs, formulate this list into a Request for Proposals, and evaluate responses from system suppliers. Members of the review committee consisted of two (2) from Forest Inventory/Forest Management, two (2) from the Department of Natural Resources Systems Section and two (2) from manitoba Data Services, the control data processing agency for the Province. The committee of six (6) provided a good cross section from Forestry, Resource computer systems and computer operations and equipment selection, which was not possible to attain in a single individual at the time. The membership of the committee significantly aided the selection process.

The first committee activity was to send out "Requests for Information" to known system vendors providing general information of our intent and outlining our basic requirements for a G.I.S. Over twenty requests were mailed out in order to identify vendors who would be interested in receiving an opportunity to present a proposal.

The second committee activity was the most time consuming and exhausting of the procedures followed but also the most critical to complete in an acceptable manner if future "surprises" were to be kept to a minimum. A detailed list of all known input information was assembled, along with estimates of quantity and extent where appropriate (Appendix I). In addition, samples and descriptions were provided for each input component to identify the nature of the need. This activity was followed by the identification and listing of all user requirements. (Appendix II). In each case, further information was included to indicate which requirements were "Musts" and which were only "Desirable".

The list of inputs and the requirements were assembled into the Request for Proposal to provide vendors a complete indication of known needs and the extent of the data base involved. An acquisition and implementation schedule was established indicating the timing of events including the deadline for receipt of proposals, bench marking requirement timing, system selection and contract negotiation, system installation, system testing, user training, and operational acceptance.

Additional components included with the request for proposal included items related to installation requirement including estimated set up time, estimated testing time, space requirements, site preparation requirements and any special installation or environmental conditions. System maintenance cost and coverage were requested to assure prompt response and effective coverage for unforeseen occurrences. A financial statement framework was provided to assure that all vendors provided information on the same component grouping basis. Costs were required separately for hardware components, system software, specialized software, third party software, workstations, storage devices, transportation, installation, testing, documentation, training and any additional requirements. All prices were required to be in Canadian Funds to provide for consistent cost comparisons between vendors.

As a final component of the Request for Proposal, an outline was presented for all vendors to follow in their response. This outline sequenced all information requested in a set format which was intended to provide the selection committee with comparable vendor responses (Appendix III).

The Request for Proposal was assembled and distributed on December 19, 1984 to the five interested vendors who replied to the initial Request for Information. With the mailing of the requests for proposal, the committee assembled a selection Matrix listing all user requirements presented in the proposal and all the system vendors involved. A simple rating system was set up where: "0" was given if the vendor indicated the system could not do the activity or no response was made; "1" was given if the extra cost option as involved; "2" was given if the system could do the task; and "3" if the system could do more than basic task requirement.

Vendor proposals were received back on January 18, 1985 and the evaluation was carried out effectively as planned from that point on.

The time spent on the Request for Proposal contents and formatting provided vendors an opportunity to respond in a structured manner which permitted the committee to carry out the final evaluation and selection within tight time constraints. To this date, no surprises have resulted from the selection process.

SETTING UP THE SYSTEM

The request to commence site preparation activity was sent out in early March, 1985. Difficulties were encountered in meeting schedules almost immediately. The location of the Forestry Branch is on the top floor in a three-storey leased building, a situation which required considerable negotiations and co-ordination between the building owners and Government Services.

The information provided by the successful vendor indicated all site preparation requirements. Carpeting was removed from the room to be dedicated to the computer installation and non-static tiles were put in place. Electrical contractors installed required wiring in the appropriate locations. At this point, electricians discovered that the power requirement of the computer room installations exceeded the electrical capacity of the building. New capacity was installed in response to the shortage in the form of a dedicated line to the system. This proved to be the only surprise related to system hardware and software installation. The climate control requirement for the computer room resulted in the installation of a complete self-contained climate control unit for heating, cooling and humidity maintenance operating on a 24 hour basis. The unit arrived complete with a crane to install the condenser unit on the roof of the building and a crew of four men to maneuver the main control unit into the computer room. This carefully calculated operation came briefly to an end when the door to the room proved to be too narrow. This surprise ended with the installation of a larger door in the hole left where the original door stood.

The final surprise in the installation process came as a result of a phone call concerning the Newfoundland Forestry installation. A "heat up" situation had occurred in their computer room which lead to damage to their computer. In response to this potential problem, an automatic high temperature control shut-off was installed in the Manitoba installation to shut off power to all hardware components should over-heating occur. One week after installation, a problem occurred in the climate control system resulting in minor overheating. The computer system automatically shut down in response to the problem with no damage resulting to the system. The final component required in the selection process was staff training. This activity was carried out in the last two weeks of July, 1985 and involved digitizing workstation, supervisory, and professional staff system training appropriate to their level of system operation. No particular difficulties were encountered during the training process. All subsequent training requirements, relating to new staff through staff turnover and the introduction of a second shift, have been handled from within the Forestry Branch by the appropriate levels of system operators.

The operational Geographic Information System was accepted by the Manitoba Forestry Branch in the first week of August, 1985.

The Forestry Branch has been most satisfied with the results of the system selection process implemented by the selection committee. A well documented "Request for Proposal" which permits system vendors to respond to indicated needs is the key component in the selection process if surprises are to be kept to a minimum.

APPENDIX I

MANITOBA FORESTRY GEOGRAPHIC INFORMATION SYSTEM

INPUT INFORMATION LISTS

1. Forest Resource Inventory Maps
2. Forest Wildfire Maps
3. Natural Disaster Maps
   - Wind, drought, flood
4. Forest Insect and Disease Maps
5. Silviculture Activity Maps
6. Timber Management Activity Maps
7. Soils Maps
8. Land and Resource Use Maps
9. Forest Resource Development Proposal Maps
10. Utility Corridor Maps
    - Proposed and/or actual
11. Forest Capability Canada Land Inventory Map
12. Satellite Imagery
    - Landsat and variations

MANITOBA FORESTRY GEOGRAPHIC INFORMATION SYSTEM
INPUT INFORMATION LISIS

	Input Description	Number of Map Sheets	Physical Dimensions cms		Input Scale	Number of Polygons Per Map Sheet		Length of Polygon Boundaries per Map Sheet		Number of Points Per Map Sheet		Present Map Projection	Polygon Attribute Data Source	Map Projection desired in addition to input Projection	Output Scale	Minimum Estimated Number of Map Sheets Output	Minimum Estimated Annual number of formulated Reports
		Available	Typ	Max		Typ	Max	Typ	Max	Typ	Max					Minimum	
I	Forest Resource Inventory Maps	4,000 total	70x70	90x130	1 15,840	500	2,500	3,000	15,000	75	200	Twp & Rge	Forest Inventory Data Files Computer stored	U.T.M.	1:20,000 1 50,000 Summary 1 1,000,000	5x the Number of sheets input per year Consisting of 1-Mylar (1 20,000) 1-Mylar (1 50,000) 3 to 4 color coded paper prints	4 per map sheet 5 per Forest Mgmt Unit 5 per Forest Section ? for Province
		500 total 400 map sheets per year per shift for present forest section	35x35	90x130	1 51,680	200	700	500	1,000	25	100	Twp & Rge	Forest Inventory Data Files Computer stored	U T M			
		Future 25 total (represents a further 2,500 map sheets to cover Province at 1 31,680)	50x60	90x130	1:250,000	500	2,500					Transverse Mercator (N I S Series)	obtained from map surface	U T.M	1:200,000 Summary 1:1,000,000	Minimal (Tundra/ Transition zone)	4 per map sheet
II	Forest Wildfire Maps	500 per yr	20x20	70x70	1:63,360 1 31,680 1 15,840 1:250,000	1	20	Variable Fire Boundary Overlay on F R I maps				Twp & Rge	Forest Inventory Data files computer stored	U.T.M.	1:50,000 1:200,000 Location Summary 1:1,000,000	5 summary maps per yr.	2 for each map sheet 5 for each Forest Mgmt Unit 1 for Province
III	Natural Disaster Maps (wind, drought, flood)	80 per yr	20x20	70x70	1 63,360 1 31,680 1 15,840 1 250,000	1	20	Variable Area impacted boundary overlay on F R I maps				Twp & Rge Transverse Mercator (N I S Series)	Forest Inventory Data files computer stored	U T M	1 50,000 1 200,000 Location Summary 1 1,000,000	5 summary maps per yr.	2 for each map sheet 5 for each Forest Mgmt Unit 1 for Province

MANITOBA FORESTRY GEOGRAPHIC INFORMATION SYSTEM
INPUT INFORMATION LISTS

	Input Description	Number of Map Sheets	Physical Dimensions cms		Input Scale	Number of Polygons Per Map Sheet		Length of Polygon Boundaries per Map Sheet		Number of Points Per Map Sheet		Present Map Projection	Polygon Attribute Data Source	Map Projection desired in addition to Input Projection	Output Scale	Minimum Estimated Number of Map Sheets Output	Minimum Estimated Annual number of formulated Reports
		Available	Typ	Max		Typ	Max	Typ	Max	Typ	Max					Minimum	
IV	Forest Insect & Disease Maps	100 per year	20x20	70x70	1:63,360 1:31,680 1:15,840 1:250,000	1	20	Variable Area Impacted boundary overlay on F.R.I. maps				Twp & Rge	Forest Inventory & Forest Protection Data files computer stored	U.T.M.	1:50,000 1:250,000 Location Summary 1:1,000,000	20 summary maps per yr	2 for each map sheet 5 for each Forest Mgmt Unit 1 for Province
		30 per year	20x20	70x70	1:2,000	Street layout & point data				1,000	25,000	Transverse Mercator (N.T.S. Series) Viable	Dutch Elm Disease computer stored	U.T.M.	1:20,000	20 summary maps per yr.	2 for each map sheet
V	Silvicultural Activity Maps	300 per year	20x20	70x70	1:63,360 1:15,840	1	50	Variable Area Impacted boundary overlay on F.R.I. maps		(regeneration survey plot location)		Twp & Rge	Forest Inventory & Siviculture data files - new and computer stored	U.T.M.	1:20,000 1:50,000 Location Summary 1:1,000,000	100 summary maps per yr	4 for each map sheet 10 for each Forest Mgmt Unit 10 for Province
VI	Timber Management Activity Maps	500 per year	20x20	70x70	1:63,360 1:15,840	5	50	Variable Area Impacted boundary overlay on F.R.I. maps				Twp & Rge	Forest Inventory and Timber Mgmt new and computer stored	U.T.M.	1:20,000 1:50,000 Location Summary 1:1,000,000	20 summary maps per yr	4 for each map sheet 10 for each Forest Mgmt Unit 10 for Province
VII	Soils Maps	5 per year (accelerating)	60x60	90x130	1:20,000 1:125,000 & others	200	2,000	Variable to provide overlay of forest cover & soils for productivity analysis				Project areas Twp & Rge Transverse Mercator (N.T.S. Series)	Obtained from map surface portion of map source will be in digital & computer stored format	U.T.M.	1:20,000 1:50,000	20 to 100 overlays on F.R.I. map sheets per year	4 for each map sheet 4 for each Mgmt Unit
VIII	Land & Resource Use Maps	Up to 400 per yr for areas on F.R.I. map sheets	20x20	90x130	1:15,840 1:250,000 & others	20	200	Variable Area Impacted boundary overlay on F.R.I. maps				Twp & Rge Project areas Transverse Mercator (N.T.S. Series)	Obtained from map surface	U.T.M.	1:20,000 1:50,000 Location Summary 1:200,000	20 to 200 overlays on F.R.I. map sheets per year	4 per map sheet 5 per Forest Mgmt Unit 5 per Forest Section 2 for Province

MANITOBA FORESTRY GEOGRAPHIC INFORMATION SYSTEM
INPUT INFORMATION LISTS

	Input Description	Number of Map Sheets	Physical Dimensions cms		Input Scale	Number of Polygons Per Map Sheet		Length of Polygon Boundaries per Map Sheet		Number of Points Per Map Sheet		Present Map Projection	Polygon Attribute Data Source	Map Projection desired in addition to input Projection	Output Scale	Minimum Estimated Number of Map Sheets Output	Minimum Estimated Annual number of formulated Reports
		Available	Typ	Max		Typ	Max	Typ	Max	Typ	Max					Minimum	
IX	Forest Resource Development Proposal Maps	10 per year	20x20	90x130	1: 250,000 1: 500,000 1: 1,000,000	1	10	Variable Area Impacted boundary overlay on F R I map base		Circle or Corridor genertion around processing centre		Project area Twp & Rge Transverse Mercator (N. I. S. Series)	Forest Inventory data files computer stand format	U. T. M.	1: 20,000 1: 50,000 1: 200,000 1: 1,000,000	20 to 200 overlays on F. R. I. map sheets per year	5 per proposal
X	Utility Corridor Maps (proposed and/or actual)	10 per year	70x70	90x130	1: 15,840 1: 63,360 1: 250,000 & others	2	5	Variable				Twp & Rge Transverse Mercator (N. I. S. Series)	Forest Inventory data files computer stand	U. T. M.	1: 20,000 1: 50,000 1: 200,000	10	5 per map sheet output
XI	Forest Capability Canada Land Inventory Map	20 total	50x60		1: 250,000	100	1,000					Transverse Mercator (N. I. S. Series)		U. T. M.	1: 20,000		
XII	Satellite Imagery (Landsat & variations)	60 images total	20x20		1: 1,000,000							Satellite Image	Digital format to be matched to F. R. I. map format	U. T. M.	1: 20,000 1: 50,000		

APPENDIX II

MANITOBA FORESTRY GEOGRAPHIC INFORMATION SYSTEM

USER REQUIREMENT LIST OUTLINE

1. Map File Preparation
   - Location description
   - UTM co-ordinate value entry
   - All stands and types
   - Stand attribute identifiers
   - Photo centre and numbers, section covers and road allowances
   - Data to be stored in polygons, attribute files or overlays
   - Edgematching

2. Area calculation of all polygons including single line features such as railroads

3. Map Production
   - Plotted on mylar
   - Plotted on paper
   - All established boundaries
   - All labels
   - All location identifiers

4. Data Manipulation
   - Analysis of effect of management decisions
   - Consider analysis
   - Area Analysis
   - Buffer zone analysis
   - Wildfire loss analysis
   - Overlay analysis (125,000 polygons at a time)

5. Updating
   - Review map and associated attribute files
   - Opportunity for future satellite digital data applications
   - Review status and ownership boundaries
   - Enter new features as they are constructed
   - Wildfire area and loss calculation and revision of original forest cover data

6. Thematic Mapping
   - Colour code and shading code options to identify selected forest stand attributes
   - Determine a new colour code or shading code based on results of polygon overlays

7. Site Specific Information
   - Integration of town street maps into data base where specific items at large scale (1:500-1:2,000) are to be positioned

8. Data Entry Options
   - Keyboard data entry without tie up of graphic workstation terminal
   - From tape files

9. System Functions
   - Digitizing - point and line features
   - Polygonization - areas connected to form polygons - built in editing routines for overshoots, undershoots and open polygons
   - Drawing/Editing - commands to support including editing verification
   - Alpha Numeric Data Entry: stand attribute data entered through keyboard on tape file
   - Editing: duplicate lines/polygons
     open polygons
     overshoots
     undershoots
   - Symbolizing
   - Merging and dropping lines
   - Weeding/Thinning
   - Subdivision of polygons
   - Browsing
   - Check pointing and restart
   - Generation of Graphic Entities
     - lines from digitized points
     - draw circles from centre point
     - define corridors along straight or convoluted lines
     - complex polygons
   - Search by attribute
   - Redefine attribute
   - Centroid positioning
   - Windowing
   - Scale changes - full range performed in the computer
   - Projections - to increase graphic capabilities for large area mapping
   - Measurements
     - perimeter and area
     - balance areas to a pre-determined total
     - measuring and storing straight line distance between digitized points

9. System Functions (cont'd.)
- Polygon Overlay Processing
  - combine different overlays for analysis of data and plotting results of combined analysis
- Grid Analysis
- Corridor Analyzing
- Edgematching
- Rubbersheeting
- Updating
- Display and plotting
- User defined calculations relating to digitized information and attributes

10. Reports Required
- Area listing by stand numbers
- Summaries of area
- Area and volume of stands
- Summaries of volume

11. Equipment Requirements
- Digitizing workstations
- Data entry workstations
- Disk storage capacities
- Tape drive
- Query terminal
- Printer - speed
- Plotter - speed - colour pens

12. Software
- Operating system software
- Specialized application software
- Third party software to be included

APPENDIX III

PROPOSAL PREPARATION

The proposal should address all the concerns and fulfill all the requirements specified in the RFP.

The proposal should contain the following information:

1. Introduction

2. Business Plan
   - Vendor's background
   - Approach to G.I.S. System

3. Response to User requirement
   - Hardware configuration
   - System software
   - Application software
   - User system function requirements
   - Data Storage
   - Growth potential
   - Communication
   - Security and backup
   - Vendor Services:
     - References
     - Installation
     - Training
     - Maintenance
     - Documentation
   - Implementation schedule
   - Financial considerations
   - Contractual considerations
   - Programming requirements
   - Alternatives
   - Other additional information that the vendor feels is pertinent to the proposal

4. Description of systems hardware, software and functional capabilities

5. Product description

6. Brochures and spec sheets

7. Management overview

Three copies of the proposal must be submitted to Manitoba Data Services. Proposal should be placed in binders with tabs separating the major sections.

Steve Rose
Co-ordinator GIS Systems
Sir Sanford Fleming College
Lindsay, Ontario

INSTALLATION OF THREE PC BASED GIS SYSTEMS - LEARNING POINTS[1]

INTRODUCTION

For those of you not familiar with Sir Sanford Fleming College, it's a small college in Lindsay, Ontario, about 1-1/2 hours northeast of Toronto. It's associated with Sir Sanford Fleming in Peterborough which is a larger campus. We have about 1200 students and we like to think of ourselves as one of the most comprehensive schools of natural resources in Canada. We have programs in forestry, fish and wildlife, agriculture, pest control, cartography, heavy equipment, and one of the most recent programs is the GIS program. The first graduates from our program came out at the end of January 1982 and the graduates from that class found about 30% employment in the GIS mapping field. Last year we had 85% of the graduates who found employment and this year, it looks very much like it's going to be about 100%. We have taken in about 40 students per year and graduate about 21 or 22.

The background of the students enrolling tends to be about 30% with bachelors degrees, about 30% with other technician/technologists diplomas and about 30% with Grade 12. This last January was the last of the one-year federally sponsored program. The federal government has removed the funding from the program and it is now being changed in format to a more typical two-year technician diploma college course.

We have designed the course by semester so that people without a computer background can start in January and those that have a natural resource background and some computer programming experience can take the course in eight months.

The facilities we have are a couple of older DEC PDP-1173 systems, which the students use for basic programming. In 1985, we obtained a Hewlett Packard 1000 with about 16 stations on it running GEO-VISION, resource analysis and mapping or RAM software products, and since 1985, we have moved more into the micro-computer based areas: we have PAMAP GIS, we have the TYDAC SPAN system, PC ARC/INFO, we have AUTOCAD and GEMS survey software total station.

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[1] Note: Paper transcribed and edited from tape.

Just before I end on what the college is about, part of the key part of the program is the students work on co-operative projects and we talked a bit about what we did with the three micro products, but I'd just like to invite anybody in the room who would like to experiment with one of those projects or have a small project done, we would like to try to get the students doing real life projects, so please see me afterwards or whenever is possible if you are interested in us undertaking a project at little or no cost unless we have significant out-of-pocket expenses.

My background is more from a mini and mainframe environment and this PC world. MS DOS was a wonderful thing, but in getting all these bits and boards sorted out, the worst problem I've had was the cabling. It may seem like a small thing but it seems that the manufacturers haven't got together on these 25-pins and 9-pins and some of them are male and female, so in a small town like Lindsay, it is particularly impossible to get parts. Similarly, in forestry you just can't run downtown Toronto and pick up these extra little bits that make things attach, such as this extra little black bit that changes a 9-pin into a 25-pin, or this little black piece called a gender changer that changes things around for you. We, at the college, already have different types of digitizers and plotters, etc., so we are always buying and trying to mix and match and move things back and forth so we end up with all these extra little bits to make the cables attach.

I apologise for this slide[2] but again we are trying to define with the vendors to say "What do you have?" - "Well, we've got a HP 74/75A plotter" - "Do you support that?" - "Oh yeah, yeah, no problem - we support that" - "What kind of ports has it? - "Well, parallel port (Proctor & Gamble)" - I come from a Hewlett-Packard environment so parallel port to me means an HPIB or IEEE parallel port, so we gave the vendor that information and lo and behold when it comes in there's no similarity at all. So well we've got to change the port on this plotter and it turned out it was going to be almost as much money, within $100 or $200 to change the port as it was to buy a whole new plotter. These plotters were around the $2,000 mark.

Another issue we had is with digitizing tables. They are another scourge of mine. We have a CALCOMP 9000, CALCOMP 9100, a large ALTEC, and a couple GENCHUNS, and we were trying to get the cabling between them sorted out and they have funny little electronics that I don't pretend to know that much about digitizing tables. We have ARC/INFO and we weren't having any luck with the CALCOMP so the manual says no problem and we got pin connections from California and we still haven't got the CALCOMP working. Finally in desperation, the project is moving along and the students graduate and they need it so we managed to phone Vic Popowich from GENCHUN and said "Please send us a table and it's got to fit with ARC/INFO". He said "Fine, I'll send it to you, Steve". I've still got the invoice and meant to take a slide but as you can see my film jammed - but I got the invoice and it's got this ARC/INFO modification - $100. It works! I've got no idea what this ARC/INFO modification is, whether it's a real piece or not -- I've no idea what it is - I paid $100 for it and it works!

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[2] Note: The series of slides used in this presentation were not available at time of publication.

Another thing that happened was with the TYDAC system. We had to get a colour enhanced dot matrix printer. We had an open house coming up at the end of January, the printer arrives about the second week in January, we had been using a black and white up until then, we thought well this is great, now check the cables and we've got all that sorted out, we got the exact specifications from the manufacturer, wasn't going to muck around with this one. Now you think when you've bought a colour plotter that it would come with a colour ribbon, but such was not the case - it came with a black and white ribbon! So about six weeks later, we still haven't got the coloured ribbon, by the way, we've put it on fast order from Toronto and it's not there yet.

Manuals are another issue, particularly in the educational environment, you can imagine when I get 20 students continually using manuals what kind of shape they end up in, and so trying to make arrangements with the vendors for multiple copies of the manual or provision for the right to photocopy them is still a big issue. The other thing is the main manuals up there - this happens to be the PC ARC/INFO manual - the main manuals aren't too bad. You have on the left here, the MS DOS manual, the INFO manual and the ARC/INFO and the ARC/PLOT manual -it's all these other little guys and bits and pieces of software that come with the EGA card and the I/O card and the printer manuals that can cause problems. You don't really ever have to use these until something real funny happens. The problem I have with DOS, and working with students, is that they have these couple of files called CONFIG.SIS and AUTOEXEC.BAT that students tend to try to muck about with. Any of you that work with PC know that they're best left alone and so they did something, they took out the reference to the COMMAND.COM file, so when it came up of course nothing happened with our system on the COMPAC 386, we are running the ARC/INFO on it, I don't know why this happens but it comes up and one of the first things you can do is it says, "Do you want to run the disk diagnostics, just hit any key and we'll get you into those disk diagnostics". So the students figure "This is a good idea, it's not working so run the disk diagnostics" and then nothing would work, we couldn't boot it, we couldn't do anything!

So now all these other little manuals, you have to take them out of the package and see what's in them. So we get the PRIME - it's got 132 megabytes PRIME disk drive in it, we get into there and lo and behold on Page 5.3, it tells you very plainly in the section on F disk, I believe, it says, "WARNING - do not run the IBM disk utilities on this drive". They do something on the end where they stick their information about the bad track information and it's going to overwrite that. So that's what they did. About 16 hours of processing later to go through and refine the thing reads and writes this bit pattern about 800 million times to every byte along the disk, so I think it was about 16 hours to re-format that 132 meg drive and get it back into production. So that's my hardware horror stories.

The best success we've had by the way was with the PAMAP system and the trick was that the PAMAP system was a vendor delivered product. They sold us the computer, the digitizer, everything came from them and that cost us a little more money. At the college, I try to stretch every dollar as far as I can and actually most of this stuff I can write off as "good education for the students" but that's harder to write off in a production sense. So I would recommend that unless you have a very highly qualified systems staff that likes all these boards and making cables fit together, that when you are buying one of these systems or micro-based system, look at getting a solution from a vendor and if anything is missing you can call them up and say this cable doesn't fit, send me a widget that makes it fit.

The other learning point is not to be on a real critical time path. With two of the systems we did this year, we committed to doing some projects and getting all these bits and pieces in place took awhile.

The other thing I would recommend in terms of hardware is the disk drives are starting to get big enough in these outfits that messing about with floppy disks for backup, etc. is a real chore. We don't have one yet, but I am trying to get a streaming tape drive backup unit and I would strongly recommend that in a production environment so that you can backup regularly, like you would in a typical mainframe shop.

In terms of software, I've got to watch myself with my vendors, we like to keep a good rapport with them so I'm not going to tell you the 'ins' and 'outs' of the three micro-based systems we have, except to say when we bought them, we bought them for very specific reasons - we are an educational institute and if you know those systems, you'll know that they are actually quite different approaches.

We bought PAMAP in some respect largely because conceptually it was similar in nature to the Intergraph system and in Ontario there are a lot of Intergraph users and it was a relatively inexpensive solution to get students to the idea of levels and line weights and colours, so that was one of the prime reasons for getting PAMAP - it's has got a lot of other benefits as well.

The TYDAC system we bought principally because of its strong analysis capability and I think a chap from the U.S. Geological Survey pointed out some of its strengths this morning. It's a very interesting system in how it does analysis and its Quad III structure is very quick. Its input system is a little awkward and the output in terms of cartographic - you can't have a lot of text all over your map, etc.

The ARC/INFO system we bought principally because there are a lot of them out there and we are an educational institute, and a lot of our students end up working in ARC/INFO shops so we have it as well.

What we've learned. - This slide is from PAMAP'S GIS: It was a project that we got the students working on last September to re-do. John Osbourne who is a Director with the Forest Resources Group in the Ministry of Natural Resources - I was involved with John on their bench mark when they bench marked the ESRI product and SYNACOM product in 1986. We took their maps, information and had the students do as much of that bench mark as possible.

Because two of the systems didn't really get up and running until December, we didn't get as far along in comparison as I'd like. Next year, we hope to re-do a similar thing, whether it's with this or with a municipal system, and we'll have some information on disk space, times to do various process, times to digitize, clean, if you are in the ARC/INFO, or grid up the system in terms of PAMAPS system. What we did find within a subjective kind of level is that the systems do vary considerably in their effective ability to do various tasks. Different processes can take from 1/2 hour on one system and maybe three hours, on another to do conceptually the same thing.

The other thing we noticed, is that there is a significant difference between the AT level machines and the COMPAQ 386 and both the speakers, Alex Miller and John Mostert from Intergraph talked this morning about multi-tasking and disk space limitations on the PC. There are serious limitations. When you have an AT, that ability to multi-task, and especially with students trying to plan their work, you have to leave it to run for 3 hours, you can't use the machine for anything else. So that's a big issue and I think in a production shop the systems tend to be sold or marketed as a solution district level material. I'm not sure from my experience with the three we have that we are there yet. I think the vendors should move into the workstation environment - the 32 bit workstation with some significant disk and some networking capability. I believe it's probably the way to go. If you are looking at these smaller solutions, take some time if you want to buy one as an educational experience. Don't oversell them to your management in terms that this is going to do a lot, they just don't have the horsepower and managing files on them is a bit tricky.

The other issue is security. When I came from a mainframe environment and the first time I copied over a file in DOS - my opinion of DOS went down quite a bit, because it doesn't ask you like most mini systems would "Are you sure you want to do this?". It just quite happily writes right over the top of it.

Keeping Track. - A lot of these systems end up with all kinds of files, like one coverage in ARC/INFO, or one map in PAMAP system or on TYDAC - you end up with a lot of little files with various extensions on them and keeping track of those is a bit of a problem.

The other issue on security is most of these systems come with what looks like one of those little gender changers that usually fits on your parallel port to your printer and it's a hardware security key. No key - software doesn't run, which is the vendor's means of protecting the system. Now I don't want anybody to go back and tell my students about this but it's a very simple matter to unscrew that thing and take it with you. You then own the software and I don't anymore. This is an issue with micros within an educational environment.

Just to conclude, I guess in selecting the right system, select your software first and bench mark - have some ideas of what you want to do. I am not a real advocate of spending years and years developing fancy user needs studies, because as you become more familiar with the software, you get more and more ideas of what it can do, but have some basic ideas in place that you want and make it go through its paces and time these things and see how long, especially on the micro-computer, the horsepower makes a lot of difference in time. Thank you very much.

Pam Salloway
President
PAMAP Graphics
Victoria, B.C.

KEY ASPECTS OF SUCCESSFUL IMPLEMENTATION[1]

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[1] Note: The Editor regrets that this paper was not available at time of publication.

CONCURRENT SESSION III - "SOLUTIONS ACHIEVED"

ALBERTA'S GIS APPROACH TO LAND INFORMATION[1]

John R. Harrower
Director, Land Information Branch
Alberta Forestry, Lands and Wildlife

Alberta's approach to GIS is outlined in our Land Related Information Systems Plan and provides for a network concept. The Alberta model includes co-operation between the Alberta Government, the Alberta Research Council, private industry and the universities in building our Geographic Information Systems. This group recently went on a trip to China - I should just mentioned that there was one other member on the trip, Charlie Weir, who is the Chief Executive Officer of the Stewart Weir Group.

The purpose of our trip to China was part of a scientific and technology exchange program and in preparing for the trip we prepared some 18 lectures and those lectures were divided into the three categories of concepts, technology and applications. The results of those 18 lectures we now have in a printed format - they were very heavy on graphics and the use of slides. If any of you have an interest in pursuing some of the details, you can contact any one of us from the delegation as we all have a complete set in our individual possessions. On that note, I will turn over the podium to Bob Fessenden who will be dealing with the concepts portion.

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[1] Note: Papers transcribed and edited from tapes.

Bob Fessenden
Head Terrain Science
Alberta Research Council

As John indicated, the lecture series that we delivered in China was broken into three main sections, which are seen here in this slide[2]. A session on concepts, technology and then applications. I want to present some excerpts from the second two topics in the concept series, i.e., a brief discussion of the primary systems, a component of the Alberta LRIS and then some information on resource information for decision making. Some of this information for Alberta-based people, I think, will be repetitive but we wanted to give you some feeling for the kind of information that we presented in this lecture tour.

The Land Related Information System network may be thought of as a series of separate computerized information systems, each with the ability to share and exchange information with other systems in the network. These systems are divided into two categories, the primary systems which provide basic surveying, mapping and occupancy information about land, and then the secondary systems, which contain information on natural resources, socioeconomic and infra-structure characteristics of the province. Once implemented, users of this Land Related Information System, will be able to access the data to extract information from a number of sources and to use it for planning and management decisions.

PRIMARY SYSTEMS

The primary systems provide the common reference for the thematic secondary systems. The primary systems consist of the geo-positioning systems for accurately locating known monuments, land registries to record land tenure and land use commitments, and base mapping at a variety of scales.

The primary survey control network is a framework of very high precision monuments, randomly placed throughout the province. This survey network is part of a national program in Canada to provide first order triangulation and trilateration control. Modern survey techniques such as GPS have been used to establish these points. The survey monuments are located approximately 50 to 80 kilometers apart, additional points are added along major transportation routes and along provincial and along international borders.

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[2] Note: Slides not available at time of publication.

The secondary survey control network contains survey monuments based approximately 300 to 800 metres apart in urban areas and approximately 10 to 20 kilometers apart in rural areas. There are approximately 10,000 points in the urban network and 7,000 in the rural network. Each of these points is permanently mounted and identified. These secondary survey control points are also used as target points identified on aerial photography to provide photogrammetric control that is extended or intensified further by aerial triangulation and large block adjustment.

Shown on this slide is the method of subdividing lands in the Province of Alberta in accordance with the Alberta Surveys Act of our Legislature. The land is divided into a regular grid system consisting of townships which are approximately six miles square. A township is identified at the intersection of a particular township and range and that township is further subdivided into sections approximately one mile square. Because the meridians converge, it is impossible to lay out an absolutely square township and therefore all sections are not exactly one mile square. Each section is further subdivided into quarter sections and legal subdivisions as illustrated in this slide.

Land Registries record information regarding land parcels in the province. In Alberta, there are two classifications of land registry: one is maintained to record individual certificates of title for land owned by the citizens, and the other registry records a variety of land interests on land owned by the government. In Alberta, more than 60% of the land is owned by the government.

Base-mapping is fundamental for supporting the secondary or thematic systems used by planners and decision makers. This base provides the model of the surface of the province in a three-dimensional digital format. Digital base maps are being compiled at 1:20,000 scale for rural areas and scales of 1:5,000 and 1:1,000 in urban areas. Base maps are built upon the geo-positioning systems just discussed, thus providing an accurate base which will increase in accuracy as new data is added. The digital base is then overlaid on an orthophoto to produce the product shown in the lower portion of this slide.

All secondary systems are built on the primary systems and thus all secondary systems can be related to one another and this is a key element of the Land Related Information System concept.

That is an excerpt of the information we presented and was designed to give an overview of the primary system concept.

I want to move on now to a discussion of what I would call a prototype information theory for natural resources information. The secondary systems concept in Alberta has yet to be defined.

We are reaching the point in the Land Related Information System concept where we will very soon need to develop a secondary system strategy.

LAND RESOURCE INFORMATION SYSTEMS FOR DECISION MAKING

Land and resource management decisions are based on social needs as expressed in goals and objectives. In this particular slide, if you look to the bottom right-hand corner, you will see the term "management plans", and of course, we use management plans to articulate our particular plan for a piece of landscape. That management plan should combine an expression of the social need, which are then translated into goals and objectives and land resource policy, with measurements and assessments of the landscape. We can assess the landscape or the land base in a variety of themes and we can then combine these themes in various ways and then combine this with our understanding of policy to help us develop a resource plan.

I would like to discuss the natural resource information relative to its level of interpretation. At its most basic or disaggregated level, natural resource information consists of measurements or estimates of individual properties. Individual bits of data, while important, are not particularly useful to resource managers, but are nevertheless the underpinnings or basis of our natural resource information databases. However, for the information to be used, it needs to be grouped or generalized. One of the most common means of grouping data is spatially, i.e., the identification of map units, be they soil map units, forest cover units, etc. These are usually, in our common methods today, taken from aerial photography and recorded on to base maps. The reason for mapping is to delineate areas that are similar internally or which can be described in some consistent way and which are different from neighboring areas.

Data may also be grouped taxonomically as in soil or plant classifications systems and our various classification products, be they spatial or taxonomic, can either exist separately or in a combined form. At this level of grouping or interpretation, which I have called basic classification or mapping classification, components of the natural environment are grouped or categorized on the basis of natural groupings of characteristics but without any particular use orientations. At this level of interpretation for example, we would differentiate between a lodge pole pine stand and a mixed wood stand or between a level equestrian area and a hammocky marine, but we would not make any interpretation with regard to the use or impact of those areas.

While this level of interpretation is useful to managers, usually managers require information more interpreted than this.

As a natural resources management community, therefore, we have developed a range of more interpretative natural resource information, which can be called physical or biological evaluation. Examples are agricultural capability, sensitivity to acid deposition, habitat suitability, etc. - the list can be quite long. At this level of interpretation, we speak about the physical or biological potential or response of an area or category relative to a specific management concern, and so our level of data aggregation or interpretation is somewhat higher.

At a fourth level of interpretation or evaluation, integrated evaluation information, i.e., the physical capabilities of the landscape to support a particular use, can be merged with social and economic concerns. The integrated evaluation product may be single or multiple sector in scope. Generally, the integrated evaluation results from merging physical capability with land policy and such socioeconomic data as are required to define the land policy. For example, land may be put into various crops based on the capacity of the land to produce the crop, however, below certain market values for the crop, an alternate crop may be grown which yields a higher economic return. Not all of the land units used to grow the first crop may be equally suitable for growing the second crop. The integrated evaluation product would therefore rate the land according to which crop should be grown, on which land units, based on market value of the two crops.

At the integrated evaluation level, the product is in effect a model of a management scenario. Let me briefly review the model for you. As you proceed from the centre to the perimeter, there is an increasing degree of evaluation, an increasing degree of data aggregation and an increasing of management orientation. Generally speaking, there is also a decreasing degree of commonality of use by different sectors. It is the data or information in the centre that provides the common data for a variety of natural resource management sectors.

While that model is simple, it has helped me over the years to clarify my views with regard to first of all the nature of natural resource information and understanding that it in fact exists in a variety of degrees of interpretation. I think it has also helped me to clarify my views with regard to where inventory activities should be focussed. Sometimes it's more attractive for individual agencies to look at inventory at the physical evaluation level and indeed, it may be more cost effective for individual agencies to think about inventory at that level. However, at a provincial level, it is probably more cost effective to collect information at the basic level of classification and then to generate the physical and biological evaluation products by automated explicit means. The forest site may be a case in point and we should ask whether we should, in fact map forest site directly for example, or should we generate a concept of forest sites from combining information such as soils, vegetation, digital train models, climate data, using an explicit algorithm. The four levels of information may exist at several scales of resolution from very small to very large.

This slide presents a model of the levels of decision making relative to information collection, analysis and presentation. Reading from left to right across the diagram, and from the bottom to the top, strategic decision making requires synthesized data for dealing with provincial policy issues. These are dealt with by the most senior level bureaucrats and politicians. Generally, large areas are looked at, often the entire province. Small map scales, 1:1 million or thereabouts, are required to portray the data in its entirety. The data can be synthesized or collected at reconnaissance levels from such sources as satellite data.

Management level decisions are dealt with by senior level bureaucrats dealing with regional policy issues. A more detailed level of information is required and issues are frequently looked at from the standpoint of components that interact. At the operational level, policies have been established and information is required to determine the best means for implementing policy. Detailed information at large scales dealing with specific locations is required for that level of decision making.

Much of the information that we use to make decisions at various levels and for various purposes, has been interpreted and classified. When interpretation and classification are based entirely on the judgement of the interpreter, the quality of the land unit classification is dependent upon the experience and the knowledge of the interpreter. This, we could refer to as implicit modelling, because the interpreter creates a model of the landscape being classified in his mind and makes judgments in accordance with his mental model.

On the other half of the slide is an example of an explicit model, which is defined in terms of variables and their significance in relation to each other. This type of model is required for computer analysis of land and resource data. Geographic variables are classified in accordance with their overall significance, analyzed in the spatial equation that reflects the relationships of the variables to each other and a model of the potential results of a decision is produced. The initial results from the model process can be reviewed and the variables or weightings adjusted. When the model is run again, a new scenario is produced. In this way, we can explicitly define how we are in fact combining various bits of our knowledge about the natural environment and arrive at a consensus between various agencies and different individuals.

Many different models can be produced incorporating widely varied data and analysis techniques. Outputs can range from basic classification to physical evaluation or integrated evaluation products. In this example, land unit data are reclassified, weighted and combined to determine land units with the greatest suitability for deer habitat.

The process of using land and resource information in decision making can thus be summarized as:

- taking measurements of the landscape
- producing classifications and categories from the measurements
- determining the goals and objectives for land resource management
- creating models of what landscape variables, combinations and circumstances are required to support the established goals and objectives that result in management options or scenarios that we can test to see if our original goals and objectives have been achieved prior to implementing them.

Thank you very much - I hope that this was useful. It at least presents you with an idea of the things that were discussed during our recent lecture tour.

Dave Mulder
General Manager
Geomatics Corp.
Calgary

In order to accomplish the types of analysis that Bob talked about in his discussion, tools from the computer industry have been looked at to provide the analysis function on the magnitude of data that we are dealing with in reaching decisions or in providing the information on which decision making can happen. The tools within the computer industry in general have been adopted to these techniques as well as a number of specialized tools, specific to handling Geographic Information Systems. I will talk about the hardware and software in very broad terms in this part of the talk. You have heard in other discussions and other lectures in the seminars over the last couple of days, and probably will hear more tomorrow as well about some of these tools, so I won't dwell on them in any great detail.

First, let me talk about some of the hardware that is involved in this technology. The computer platforms that are typically used for geographic processing are wide and varied. Computers are used in almost everything you can think about today - from wristwatches to calculators, to your car, to mainframe computers, and actually the term 'computer' has taken on a magnitude of meaning that is a little bit fuzzy in my mind today.

The kinds of computers that are used for geographic information processing purposes, I believe can be categorized into three broad categories:

- the personal computer based systems
- the workstation based systems
- mainframe or micro-based systems.

The boundaries between these three classifications, may in fact be somewhat fuzzy and they are somewhat dependent on the hardware themselves, but more specifically, from the operating systems that these machines run on.

The personal computers, typically, are based on MS DOS or PC DOS based operating system and form a class of machines unto their own.

Workstation technology are typically workstations that sit on your desk. They are owned and operated by an individual and typically operate a personal data base and operate under a UNEX operating system. These machines are actually becoming very powerful in their own right. Processors in the order of 5, 10, 15 mip processors (million instructions per second) are coming on the market. It's interesting to note that even the most powerful mainframe computers just a few years ago were the only things that had that kind of processing. So we are seeing a very large amount of capacity being downloaded on to these types of machines.

The mainframe or mini-computers are typically classified by a variety of operating systems within a family of processors, such as the digital equipment family that has from small machines to large machines all operating under the VMS operating system, and they very often have multiple workstations, multiple terminals, and multiple other pieces of devices that hook directly to that processor. This has been the traditional data processing environment.

Other technologies are incorporated into the computer technology, input, output and the processing of data, when it comes to dealing with geographic data. Aerial photography has typically been one of the primary sources of information for Geographic Information Systems. Typically, you take the photography and float it into a stereo plotter and get either a two-dimensional or a three-dimensional model of the landscape.

Scanners have been used and a lot of research has been done over the last number of years of using scanners to scan maps and convert them into the vector form that Geographic Information Systems can use. I think it is somewhat debatable whether that technology is in fact production oriented today, and whether it ultimately becomes production oriented or not is yet to be seen. However, new uses of scanners have emerged where the scanning of the data and leaving it in a raster form as a backdrop on which vector information can be overlaid, may in fact be a more useful tool and a byproduct of the scanning technology. So scanners of large scale or small scale to handle large maps or small maps or photographs might in fact play a more important role as we progress into the future.

Satellite imagery is also a technology that in terms of data capture, is emerging as a major form of input to Geographic Information Systems. Whether that technology be satellite-based or from high or low altitude aircraft, depending upon the resolution of the data that you are trying to capture and the area of interest that you are capturing the data over, various techniques would apply. The technology associated with remote sensing is rapidly advancing. Canada, in fact, has major research programs underway in these technologies. We just had a visit from the Canada Centre for Remote Sensing earlier this week and we saw the first digital images or first paper images from the new radar satellite technology, which is going to be launched in the early 90's, where we will be using radar imagery as a data source on a satellite platform.

The workstation technology is advancing at a tremendous rate. As I mentioned earlier, the processing power that is now migrating to the workstation environment is creating a whole new definition of productivity and the use of Geographic Information Systems.

One of the key factors in this type of technology is the man/machine interface. It is the terminals, the graphic workstations where the human interface is extremely important, and a lot of technology development is going on in being able to understand the ergonomics of the man/machine interface. For example, MacIntosh have developed in their standardization a means of communicating with the machines, this is starting to have a major impact on the development of this type of technology.

Perhaps one of the most significant areas of research and development in the computer industry and in fact in the telecommunications industry, is in developing digital data networks. A network is basically a wire that connects all of the pieces of equipment together and allows data to transfer between the various pieces of equipment. Those pieces of equipment, in fact, can be computers in their own right and each node on the network plays its own function. In the traditional mainframe computer industry, the storage of data had to sit on disk drives off of the mainframe computer. That had some major limitations in terms of the distribution of the data to various users who were typically geographically disbursed. The network concept allows us to distribute that data to many processors on the network and then be able to work with it in various forms. That has given rise to the development of file servers that will allow us to distribute the data in a much more efficient manner than we have been seeing in the past.

The research that is going on in terms of being able to develop distributed data base software across the network is an area in which we can see some major developments over the next few years, and allow us to be able to migrate the data on to many processors around the network. The management software will be in place in order to know where all of that data exists without us each individually having to know where it is. That's a very rough overview of some of the things that I think are important from a hardware standpoint.

Let me talk a bit about the software. The software that relates to computer graphics technology and to Geographic Information Systems are typically based on very elementary drawing elements of points, lines, polygons, surfaces and texts, and basically, with these elements you can create virtually any type of graphics.

I will discuss a number of software tools that are used in typical computer graphics systems. You may need the ability to separate the data into different levels or layers so that you can define a typical theme on a separate level and the software needs to be able to take this into account and keep it separate. You may need to be able to handle multiple map scales, the ability to scale up and scale down, to generalize the data as you move to different scaling levels, this needs to be part of the software. The ability to translate between different projection systems are tools that the software needs to have and data may come from different sources so that the monumentation or the reference points on the two sources might in fact be different. You need to have software that will be able to fit the one source of lower accuracy to the higher accuracy base. You need to be able to do three-dimensional modelling so that we can do slope studies and be able to look at the terrain as a three-dimensional model.

A lot of those type of tools and techniques are common to virtually all computer graphic systems on the market. There are some very specialized tools that are separate and distinct when we start talking about Geographic Information Systems and particularly when we are dealing with natural resource information in a Geographic Information Systems context. What makes it different and somewhat unique is that we are not just dealing with graphics, we are not just dealing with the drafting or mapping functions, but we are really dealing with the modelling function that involves the alphanumeric or attribute data in conjunction with the maps that we are dealing with. So the inputs to a Geographic Information System are typically the maps themselves and the attributes that provide the labelling or the quantification of the information on the maps.

In addition, we require the models which allow us to take the very raw data elements that we are capturing and creating the synthesized information from that data. Foresters, for example, are not interested in the height of trees, the tree diameters or those types of very raw basic measurements. Really what they're interested in is the volume of timber over a stand, but we use the measurements of tree heights, canopy, etc., to capture the data and the models then relate directly to the computed information. Mr. Levinsohn will talk a bit more about using some of these models in practical applications.

Let me now talk about some of the tools that are generic to Geographic Information's software techniques. We need to have the attributes loaded into the computer in a form, such that the polygons which define geographic extent of the coverage have tabular information associated with each thematic coverage. We then have the facilities, the capabilities to overlay various themes of data. This is the spatial intersection of two sets of polygons to create a third set of polygons, which is the combined process of the two polygons using some Boolean logic, an Algebra expression such as "and" of the two polygon sets or "or" of those two sets, creating a third set of polygons with an associated set of attributes which can be the combination or a mathematical process associated with the attributes of the original polygons to create a third set of coverage with its associated attribute data.

Tools are available to do buffer or zone analysis. This is the ability to put a polygon around a linear element such as a road, creating a buffer zone and if we were to calculate the type of forest that was cut by putting a road through a forested area, we would intercept, using the polygon overlay approach that I just mentioned, the buffer zone with the polygon stands and we could calculate how much timber was to be cut by putting a road through a certain area.

Network analysis is the ability to connect lines and points in somewhat like a street network, so that if we wanted to determine the shortest access distance or route between two points, we would use techniques that are germane to network analysis.

Remote sensing can also be an analysis tool. This is a typical Landsat scene of an area which shows coloured spectral signatures for various land cover, in this case, forested land. The analysis portion allows us to zoom in on an area, allows an interpreter to classify according to his knowledge of what those areas on the ground represent. In the case of the white polygoned areas, he goes in and traces around a set of pixels on the screen that represent say, poplar hardwood areas or coniferous spruce. He goes through and identifies the different types of themes in the image, then allows the software to take and do a sampling of the pixels within those polygon areas and apply that to the entire scene and therefore producing a classified image, in fact, being able to put polygons around those images and producing an output. We can change the colour or produce it in a polygon form if they wish. The results, would be to create original data from satellite imagery or in fact, to merge that technology with the vector systems of a computer graphic systems so that we can use satellite imagery as a background for analysis purposes. This happens to be some data from the B.C. Forest Service that is a combination of the vector data from their maps overlaid on a remote sensed image.

Those are just some of the techniques that are germane to this technology and are being used in Geographic Information Systems by practitioners of the science.

Allan Levinsohn
Consultant
A. G. Levinsohn Inc.

The theory and technology are fine but what does it mean to the land manager is who actually wants to accomplish something with a GIS. What I'd like to do in the next couple of moments is talk about the basic concepts that are associated with Geographic Information Systems, such as the data structures, how we organize information and information theory in terms of being a model based classification, and how they relate to actual forest management concerns.

The kinds of things we are interested in, are where we should place our roads and the distances that we have to travel to the mill, the grades - how much it's going to cost us to get there. We have concerns about where we can use the equipment, the scheduling of that equipment, what terrain is suitable for it, what tree sizes are going to be there, can we, in fact, use a delimber or a feller buncher or do we have to go out and do it with chain saws and other related activities, such as update from fire or the prediction of fire spread, to mention a few.

Let's take a quick look then at how we might be able to use some of the concepts that the previous two speakers related to for doing some of these activities. For example, there are well-known regression equations for being able to calculate stem breakage as a result of harvesting operations. These were function of percent slope, tree diameter, tree height, tree volume and percent defect in the tree. We would normally make calculations like this on either a tree by tree basis or on a stand by stand basis using a Geographic Information System and the modelling approach would allow us in fact to take that regression equation and multiply it across the entire map coverages and bring those together inside a spatial equation that could then give us a map of predicted breakage as well as a report of the amount of volume that we might lose.

Another example would be in the planning for hauling and the location of haul roads. We can take stand data, a digital terrain model, geomorphology including soils, and hydrography. We can reclassify them using a costing equation, using geotechnical information with the geomorphology, using a harvest scheduling equation for calculating the stands that we want to access first. These would give us then volume and merchantability, a road grade or a cost data base and a road construction cost out of the geomorphology data. We could rasterize this or we could use a terrain integrated network technique and merge data, using spatial overlay techniques and come up with land units by cost and road grade, for example, and again using spatial overlay techniques, come up with alternates routes, based on being able to optimize various techniques.

Since this slide was made[3], we've progressed a lot further in our research and now we have a well-defined concept that we are in the process of testing, that will actually allow interactive optimization of various criteria for road location. Some of the other things, of course, that we need to do is maintain the data base, and we have to do updates after fire. The next model here shows a technique where we would take satellite imagery and using a classification algorithm for rectification and identification of the burned over areas, we would identify those within the satellite image. We might use topographic data from our topographic data base to effect the geometric correction, if it hadn't already been done. We could do a raster to vector conversion that would give us the burned over polygons. We can tie that back into our forest inventory data base, we would produce a report of the depleted areas and we could go back into a holding file that could be checked by a supervisor somewhere, prior to going back in and updating the original forest stand data base.

These are some early examples of the kinds of things that we've done. We can do similar things for wildlife. Wildlife management is becoming an increasing concern and certainly the relationships between forest harvesting operations and wildlife habitat. This is the same model for deer habitat classification that Bob showed you earlier. This is an example of a far more complex model - the significant thing here is that the tools that were spoken of earlier in Dave's presentation are all the same ones that are being used here. The complexity of the model is purely a reflection on the number of steps that the data is processed through and how these processes are strung together.

In summary then, we can take the goals and objectives and produce models that then lead to the management options that Bob talked about, but what I'd really like to do very quickly, is to just skip through a natural example. Some of these others were specific to forestry but they're rather hypothetical. The process I am going to talk about now uses all of the techniques and the modelling applications that were just described to map the entire southern white area that you can see, leaving out the Peace Area - it's about 90,000 square miles and it was mapped for 22 different recreational activities. We went through a process of defining the requirements and the models, assembling the data, bringing into place the hardware and software, programming the models and so forth. So we had a procedure that we went through that began with defining what the models had to be able to do, the data inputs that were required for it and then actually processing those data.

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[3] Note: The series of slides used in this presentation were not available at time of publication.

This is an example of a hard copy of the model that was developed. It is a simple numeric model using weightings and multiplier and additive techniques to come out with an overall suitability index for recreation. It was all developed on an AT, we completed about 90,000 square miles, 300,000 individual grid cells, with approximately 200 different variables for 22 different recreational activities.

The outputs were either in the form of a pen plot or on a very simple and inexpensive $1200 dot matrix printer where large maps were produced in panels and were then subsequently glued together with different levels of suitability being identified with different shading patterns. What this process demonstrates is that it is possible to do model-based classification for various suitabilities.

This is where the real payoffs are in Geographic Information Systems. If GIS is used merely as a sophisticated CAD/CAM system or a mechanism for automating manual processes or for reproducing existing print media maps, then the payoffs are not going to be there. This allowed unsupervised classification of 90,000 square miles of the province and with the result that we were able to do it for about four cents a quarter section per recreational activity. What facilitated this was not merely the technology, because the technology was really the smallest part of it in many respects. It was the vehicle that allowed us to do it, but what really facilitated it was a dedicated multi-disciplinary team that combined knowledge of the recreational activities with modelling techniques, with programming techniques hardware and software and the capability subsequently to be able to produce the final outcome.

What we had hoped to show you in this very quick overview today is some of the many aspects that go into designing a Geographic Information System or that go into using GIS as an effective tool in resource management and although the technology is one of the glitzier parts of it, it is not as significant in many respects because you could in fact do some of these things manually although you'd need an awful lot of people involved for a very long period of time. What is far more important is combining a comprehensive knowledge of the landscape and the way that data are combined to give us real information about the landscape and then be able to apply that to management decision making. Thank you.

QUESTIONS AND ANSWERS

STEVE ROSE: From your trip to China, can you say what some of the results were in terms of technology transfer, projects you brought back to Canada, whatever?

BRUCE MacKENZIE: OK, let me paraphrase that for the tape recording outside. I understand that the question is what were some of the technology applications that the people here were able to carry through to China and discuss with them and what's resulted from those discussions.

JOHN HARROWER: If I might just comment that China is very eager right now to advance its technical know-how in these areas. One of the concerns, of course, that they all have in that part of the world is the lack of funding to make purchases of the kind of technology that we're talking about here. In the case of the agreement that has been established between the Alberta Government and the province of Heilongkiang, it results in what we refer to as a right hand/left hand concept where the Chinese have given preference to Alberta firms to sell in to China in exchange for some of this technology and to date this year there has been recorded over $100 million worth of sales by Alberta industry into China and, of course, the cost of giving them this kind of technology is quite low relatively speaking. It is interesting to note as part of the exchange agreement, there are people coming from China for six months to a one year term to work along side our people in the field, and we also have people going over there learning similar technologies. To give you an example, the exchange goes far beyond just the GIS and mapping area. An interesting point that we learned was that some of the herbs that are used in cures in China have been observed and reviewed by Canadian doctors and the active ingredients identified and are now part of our pharmaceutical industry.

ALLAN LEVINSOHN: Just as a follow-up to that, Steve, as a consequence of our trip over there and the interest that was expressed, we now have a small demonstration project with Heilongkiang that we will be starting with shortly. The essence of the project will be to develop a system for assessing or looking at scenarios for various land uses for a county just outside of Harbin, which is the capital of Heilongkiang. We're going to bring over data that relates to the area for such things as industrial land use, agricultural capability, soils, urban development and expansion, load that into a micro-computer databased Geographic Information System, develop the applications, produce some sample products, then take all of it back over there again and leave it with them - the hardware, the software, the data base, and then spend some additional time there training some of their people and using the system as a focus for some additional broader education on the concepts related to land management and the opportunities that are there for planning and integrated land use.

ALLAN LEVINSOHN: I believe the question was: Which models are we working on and are there prototypes of those that are available?

We are currently in the process of undertaking research into spatial modelling in general. A number of systems that are available now are command language driven, in other words, they are made up of some complex spatial capabilities, allow us to develop what has been coined as spatial algebra and you can imagine that everyone of these fundamental spatial tools are roughly equivalent to an algebraic expression that performs a certain function or you could think of it as a sub-routine, for any of you who are programmers. What we do is we string those functions together and apply them against datasets to produce various results. What we are working on now is really the process as a whole and the road location model happens to be an example that we chosen. It is just the first of many that we plan to build. We do not have a prototype that's available currently, although we expect that our work may be done in the next three to six months. We have done testing of the basic techniques that will go into doing it and those tests have all turned out positively and we are now in the process of identifying a test area where we will have adequate data for the implementation of those models. It may be that some of these models although they will turn out to be very interesting conceptually or in a theoretical environment but in fact the cost of implementation may be so great that we can't afford to. On the other hand, there may be models that we will develop or that we will experiment with that we will find the implementation cost is not very high and that we can get major returns from it. There is also an opportunity then to take the returns on investment from models that are not as expensive and piggyback on those models what we would otherwise not be able to afford. Rather a long-winded answer to your question - No - there are no prototypes available currently, Yes - we are working on a wide range of models and the road location happens to be first one that we selected to work on.

AUDIENCE: We've got all this fancy equipment and all these "neat" things that we can do and we've heard a little bit about these primary systems that are supposed to be in place, I think that the big problem that we have is that they don't have any good data that we can use on all these systems. So I would like to know 1) What is the status of the primary systems that were previously described? 2) What are our projections timewise to get all of these secondary systems with the real data in there that we can use?

PANELIST: With regard to the primary initiative, the provincial government of Alberta committed itself in 1978 to completing the establishment of the geo-referenced network and the control that was required to put the primary system and the base mapping components in place. That was a ten year program at a cost of $10 million and has now just been completed. About five years ago, we started the 1:20,000 digital base mapping program which we consider to be the final component of the primary systems for the purposes of building secondary systems on. There's a lot more requirement in the total primary activity, but for the purposes of secondary system relationships, the 1:20,000 digital base mapping program was initiated. Right now, that is about 50% complete. It is costing the Alberta Government $20 million to put that into place and we're approximately half way through. The time line on completing it will be probably another eight or nine years to see it completely in place, but there is sufficient completed now that we'll be able to start implementing the secondary systems on.[3]

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[3] Note: The remainder of the question and answer period was not captured on tape.

SESSION IV - "SOLUTIONS ACHIEVED"

Tom Moore
Forest Officer
Petawawa National Forestry Institute
Canadian Forestry Service

NATIONAL FORESTRY INSTITUTE APPLICATIONS OF GIS

As far as GIS solutions are concerned, I felt a bit awkward coming here and talking, because I felt that some of those solutions that we have developed at Petawawa most of you people wouldn't be able to relate to because our applications are quite a bit different from those of provincial foresters. But I believe you will find some of the work we've been doing a bit interesting and it will perhaps give you a bit better idea as to some of the other activities in forestry on a national level.

The chronology of our GIS experience: In 1980, work began on a computerized version of the National Forest Inventory, mostly on contract to help us develop our GIS. Most of the work was done with the Geo-Cartographic Division of Statistics Canada, who helped us put together our first GIS data base. At that time there wasn't such a term as GIS. What we had was a geo-referenced spatial data base and a tabular attribute data base.

This is a map from our GIS and it shows you the extent of our data base. It is not as complicated as a provincial data base in some respects, but in others, it's a bit more complicated. There are 30,000 polygons, each polygon representing a provincial unit of inventory, which is typically a forest map sheet. Associated with each polygon, we have many attribute records describing the contents of that map sheet in quite a summarized form as compared to the provincial inventories, from where the information was originally collected.

The purpose of this information system is to provide information for national level analysis and as input to policy making. Some of the projects that have been undertaken: the first was publication of the National Forest Inventory in 1981 and it was published in both map form, as you see here, and tabular form. Currently, the National Wood Supply Project undertaken by the CFS will be using this data base in an attempt to try to understand Canada's overall wood supply picture on a national level and that wood supply information will be fed into an international market model to try to come to grips with how does Canada stand in international forestry markets.

Some of the products that have come out of our GIS site: This is from the data base theme of mature wood volume for selected commercial wood species and I guess the thing that is unique about this system as compared to provincial systems is the scope that we are looking at in the scale. This is typically 1:5 million or 1:10 million scale maps that we're producing.

This is another thematic map of the entire country - some of the sample product. In addition, we have been overlaying our other themes of data on the National Forest Inventory such as this acid precipitation map that was generated by the acid rain project. This was a combination of themes put together to try to get a first approximation of the scope of the acid deposition problem and to try to provide input into developing a strategy for what further research should be done in that area. The National Forest Inventory is carried out on a five-year basis and the updates come from the provinces so there is quite a strong connection between the provincial forest agencies and our group in developing this data base.

The second GIS application that is being undertaken at Petawawa is the Forest and Disease Survey. The Technology Development Centre for this group is located at Petawawa. The FIDS group has been a part of the CFS for a number of decades and their mandate is to conduct a survey of the types of insect pests in Canada and their extent. The Technology Development Centre for FIDS got into developing a GIS data base in order to help try to bring a link between the different causal agents that are associated with the pest infestation and the location of the insects. This is to try to help develop not only a monitoring capability but also a forecasting capability and ultimately to help develop a management tool for making a strategic and operation decisions about forest protection policies.

The organization of the GIS system is a VAX 750 in Petawawa that's on line to the regional establishments across Canada by a datapac and the regional FIDS units - six of them across Canada - are being set up as micro GIS systems and they are tied in to the extensive attribute data base on the VAX and share data back and forth. Survey records that are typed in interactively on the micro GISs are then batch loaded up to the main data base on the VAX for use by researchers as well as to maintain the historical data base of pest occurrence. One of the logical outlines of how the system works is the defoliation and mortality maps that are fed into ARC/INFO data base and combined with the CFRDS - the National Forest Inventory that I showed earlier, as well as some factors generated by experts as to what the impact of the defoliation mortality is on wood supply - we are trying to come up with national estimates of the significance of pest species.

Here is one of the projects that they're involved with, a pilot project in New Brunswick. This is an overlay of five years of defoliation mapping on the province and which has classified areas by number of years of defoliation within a five year period. Consecutive defoliation will lead to mortality, ultimately, of the forest stands. This was overlaid on top of the forest inventory to give an estimate by forest type and by age of the forest stands, how much growth was foregone because of the insect occurrence and this can help in developing a strategy for how much money should be spent on the protection program and what area should it be targeted on.

The next step in the program is to link the defoliation information with a much more detailed provincial forest inventory to help put together tactical programs for forest protection.

To switch gears a bit here, I would like to talk a bit on some of the research work that we're doing with some remotely sensed imagery. Petawawa is mostly a research institute although we do have several operational programs, and my main focus in the past few months has been the research side. The motivation for trying to develop an inventory system from the MEAS inventory is to try to get a better estimate of the kind of diversity within a stand. One thing that I've noticed about most forest inventories is that they treat the contents of a stand or a forest polygon as being fairly uniformed and really the attribute list for what's within a stand is generally quite shallow. They will be classified by an average age of the stand or an average predominant species composition, but really, it doesn't give a real good indication of what kind of trees are within the stand. Using that MEAS imagery, we think that there is some potential to get a much more detailed description of individual forest stands. The MEAS sensor is a remote sensor but it's not put on a satellite, it's something that you fasten inside a plane - it's pretty similar to the multi-spectral scanners on a satellite - it's a push broom type scanner, it's an array of sensors that are lined up beside each other and as the plane flies over an area, it picks up readings up off the ground.

The MEAS II scanner is 1,000 array elements wide. The advantage of having a sensor on an aeroplane is you can change the characteristics of what it's recording by flying the plane at a different altitude or by putting different filters in front of the lenses, so you can tailor your missions to the kind of features on the ground you're looking for. This is a sample product from a MEAS mission, it's a true colour print of several channels and it's quite similar to a large scale photography product, but it also has the additional benefit coming from digital imagery that you can perform enhancements on it and try to draw out other features, make them accentuate, or enhance some of the features on the ground. This is a bit of a closer look - a study area we have been taking a look at and you will be seeing this area in some of the next slides. The imagery we have been using in the next few slides is 70 centimeters, so the pixels are about that large (that's the resolution on the ground flown at about the height of about 2,000 metres), and you can see from the imagery, you can pick out the individual trees. So the challenge that we took on is "Well, if you can see them in the imagery, is it possible to develop a pattern recognition system that can go through and identify those trees automatically".

I'll just show you what the forest is like from the ground a bit - it's about 60 to 65 years old. There's some red pine about 22 metres tall, fairly close canopy. There's some open grown Norway spruce - these are the large trees that you saw - they're about 18 metres high and some closed-in white spruce in the back. The basis for us trying to identify trees from the imagery is a model of reflectance of individual crowns. If you take a look at the figure on the left, it's a symbol of a sun casting light down on one side of the crown. We expect to have one side cast in light and another cast in shade. Looking at it from above, the figure on the right, we can expect a characteristic shape based on the geometry of the crown and the angle of the sun.

This is a surface map of reflectance on that area that has little patch covers, there are a few trees there and we can see the characteristic hilly shapes of where the trees are, that the sunlit side is casting a bit brighter reflection and has higher values than the shaded side has a depression. So our challenge was to write a program that would go through the imagery and search out these shapes and identify them as tree locations.

There are some red dots located on the screen and it seemed our first approximation was quite successful. We had a few problems - we found that using a real simple algorithm, which found peaks on the data set, the ability to find trees was very sensitive to pixelsize and using 120 centimetre data we could find big trees very well and using 30 centimetre data we could find small trees quite well, so we had a few problems but we've since moved to a more sophisticated model (a geometric model of the signature of the reflectance) and we do a least square fit to try to find the best parts of the image that fit those shapes. So that looks really promising. Going out and field testing it, we found that there was almost a perfect ability to pick out individual trees. We still have a lot of work to do yet in trying to estimate crown width by counting how many pixels belong to a certain tree shape but these are pretty early results I am presenting here and we've haven't gotten into that yet.

The next step that we attempted, was to try to discriminate the trees by their species. From the enhancement, you can see a few differences. The pink area in the middle is predominantly red pine, the green area below it is predominantly white spruce, the dark red is red spruce and the bottom pink area is another red pine stand, and across to the very far right of the image is white pine. So it appears that there is something that in the spectral reflectance values it gives off species.

The problem with conventional image analysis to try to bring out species is that you are dealing with a very complicated and noisy signal, not only are you seeing the tree tops that have a characteristic signal, but you are seeing the shaded side of the tree, a bit of the ground and some shadow. So to put a training area in a situation like that, you'd get a very uncharacteristic signal, not very good for a classification. What we have attempted to do is just use the uniformly lit sides of the trees as our training areas for classification.

In this image, you can see the training areas that we pick out and a few different stands. The results of the classification, if you follow along the diagonal, the red pine was classified correctly 87% of the time, red spruce 97%, white spruce 93% and white pine 78% of the time. So it was surprisingly good results from the species classification by isolating only a single uniform pixel from each tree. These were the classification results from our training data set on a separate independent test data set, using that classifier, we got the same high values.

This is showing the training areas and the test areas, coded by species. Most of the noise came from the white pine area which is the blue area on the right and going back and taking a look at the area, driving out and walking around, we found that was comprised of about 35% red pine and our classifier turned out to be better than we were, as it identified most of those red pines within the stands.

The next step of the project will be an attempt to estimate individual tree heights by developing a stereo model of the surface of the tree tops and a digital elevation model of the ground. One of the benefits of the MEAS sensor is that there are eight channels and we can angle those forward to any degree we want. On some of the test data sets we are using, they've angled one of the sets forward 30% and one back 30% so we have stereo coverage of the area that we've flown over. This stereo data can be used in a manner similar to conventional stereo photography.

The steps that we are going to undertake to try to estimate tree heights are using our system of picking out individual trees, we will separate tree features from the background of ground features and using an automatic co-relation technique, we will match from the forward scene to the aft scene to estimate parallax for every feature and from that we will generate a digital elevation model for the top of the canopy and an elevation model for the ground. By subtracting these two DEMs, we will be able to get tree heights on an individual basis. We are not sure how well this is going to work. Work that has been done with stereo satellite imagery from spot by McDonald Petwhiller, they found that they could get within a half pixel accuracy in the DEMs they were generating. So for 70 centimetre MEAS imagery that would be plus or minus 35 centimeters, which is kind of unreal. It's precision beyond what's necessary.

Hopefully, by estimating species, crown width, tree height, we will be able to generate some individual tree volume functions, much along the work that was done by the Forest Management Institute in the late '60s with large scale photosampling. This is a fairly well developed technique-they've found in 1968 that they could get plus or minus 15% on plot volume and when broken down by individual trees, you can get into a lot of profile models and an estimate of the kind of quality that's in your stand as opposed to just an overall average volume figure.

Future work also would be in the area of trying to estimate stand boundaries, once we've classified the trees, using classification technique to try to delineate homogeneous areas and essentially produce stand boundary evectors.

As a final product, geometrically corrected and geographically referenced stand boundary vectors out of a system like this, 100% sample of trees in order to produce high quality, high resolution stand tables and stock tables and perhaps, stem mapped sample plots for distance depended individual tree stand development models.

The implication of this kind of data set in the area of stand development models to have models that would quite accurately reflect the volume and quality that's out there and also provide a much better baseline data set for estimating changes to the stand through silvicultural intervention such as thinning, what kind products can you take out in a thinning, what will be the residual stand and how will that change over time. Other uses of the data set that we have envisioned would be for fire spread models that currently are using very average estimates of what kind of timber type is out but to have individual tree estimates where they can forecast the potential for crowning and for fire spread by individual type.

That's some of the work we have undertaking and some of the stuff we will be undertaking over the next few years.

Chris Bowers
Supervisor, Forest Information System
Fraser Inc.
Edmunston, New Brunswick

FRASER INC. - A COMPANY'S APPROACH TO GIS

ABSTRACT. The growth in Forest Information Systems has been predicated by a need for better management of a dwindling forest resource. Fraser has been involved in G.I.S. technology for the past four years. This involvement was required to meet the forecast and planning functions outlined in the 1982 New Brunswick forest management agreement. The E.S.R.I. ARC/INFO system was determined to best fulfil the mapping, data base and analytical needs of Fraser's Woodlands Division. The key to G.I.S. success has been a commitment of staff and budget dollars to the system. This commitment has resulted in solid operational mapping and innovative forest management techniques.

FRASER INC.

Fraser Inc., part of the Noranda Forest Group, is a forest products company based in northern New Brunswick. It operates two pulpmills, a papermill, and two sawmills in the province. Fraser's Woodlands Division manages 400,000 hectares of company owned land and 400,000 hectares of crown land. As licensee, Fraser is responsible for all operational management of the crown areas. Allocations to sub-licensees, wildlife studies, and small woodlot management are also part of Woodland's responsibility.

WHY G.I.S.?

Maps have been a part of forestry for many years. The accuracy needed for forest stand typing was within basic map drafting capabilities. Equally familiar to the forester are the volumes of information collected from photo interpretation and round surveys. Management, based on these two separate information sources, proved inadequate in the face of a decreasing fibre supply and a heightened awareness of environmental concerns.

G.I.S. provides the vehicle to combine the spatial map information with the tabular data. A locational reference and area-based statistics enable detailed management from a provincial scale to the daily requirements of a silviculture supervisor. Typically, a significant increase in computer power accompanies a G.I.S. This gives the manager new word processing abilities and data base management potentials.

After the considerable task of establishing a complete information system, ongoing requirements such as map updating, operating reports, stand lists, and area summaries become routine.

WHICH SYSTEM?

The 1982 New Brunswick Crown Lands Act hastened the acquisition of G.I.S. by Fraser Woodlands. After initially determining what systems were available, several different options were considered. As a result, two formal proposals were received, both were mini-computer based.

The E.S.R.I. ARC/INFO system produced in Redlands, California, was chosen as the system best able to perform the variety of geoprocessing and data base task we required. In fact, ARC/INFO was the only G.I.S. fully operational in forestry at the time. Additionally, the same system had been purchased the year before by the New Brunswick Department of Natural Resources and this compatibility was essential. The availability of trained people from the Nova Scotia College of Geographic Sciences also influenced our decision.

The hardware purchased with the G.I.S. centred on a Prime 2250 mini-computer with 300 megabytes of disk storage. This is a multi-user system configured with six data terminals. A single graphic workstation was included, consisting of a Tektronix graphics terminal, and a CALCOMP 9000 digitizing table. The output devices purchased were a CALCOMP 1073 four pen plotter and a 300 line per minute dot matrix printer. It should be mentioned that the disk storage capacity was doubled to 600 megabytes within two years.

In the spring of 1984, two people were hired as G.I.S. staff within the Woodlands Division. A third person was brought in approximately six months later. Several of the foresters and technicians in the department were trained in the concepts and use of the G.I.S. This staff has been critical to the success of Fraser's information system.

BUILDING THE INFORMATION BASE

Work on a new forest inventory had begun before the hardware was in place. The 800,000 hectares of woodland were flown and a new set of 1:12,500 colour photographs were produced. These photos were interpreted and transferred to 250 map documents ready for digitizing. The interpretation and mapping went on concurrently and took two and one half years to complete with a staff of five technicians.

The Crown areas were digitized by the New Brunswick Department of Natural Resources and the 100 freehold maps digitized by Fraser. All processing and plotting has been carried out on the Fraser system.

Initially four map layers were digitized, forest inventory polygons, roads and streams, photo centre points, and ownership boundaries. On average three days were spent digitizing and correcting each map.

The inventory data for the 60,000 stands were entered by the corporate data processing centre and the files transferred to the G.I.S. An extensive process of map building, test plotting, and error correction continued for two years.

To keep the system current, an annual update of the entire license area is carried out. All harvest and silviculture activities are entered and approximately sixty percent of the maps are replotted each spring. This process also gives us the opportunity to add any new survey data collected during the operating season.

G.I.S. SOLUTIONS

Finding solutions to our forestry management problems began once the inventory data and map co-ordinates were automated. This is the point at which the true potential of G.I.S. can be put to use.

A basic requirement of Fraser's G.I.S. is to provide accurate, up-to-date operational maps. To take the raw digitized data and produce a fully symbolized map with detailed legends as the task. Meetings were held to get ideas on what information would be displayed and how. There was certainly some differing points of view which had to be resolved. An example would be the debate over the use of shade patterns. The people involved in silviculture thought that recent plantations should be shaded so as to highlight the treated areas, while the harvest operation people wanted the recent cuts to stand out. To accommodate both wishes using a single colour would result in a cluttered map, so a compromise was reached, plantations and cuts are drawn with distinct boundary symbols but neither are shaded.

The standard numbering system for map polygons proved inadequate for our forestry application. A method of numbering was developed whereby the stand number is based on the geographic location of the stand. This has made finding a particular stand easier and avoids added confusion after several updates.

The twenty-five year plan is the cornerstone of the New Brunswick forest management agreement. As licensee, we must determine the Annual Allowable Cut as well as where and when the harvesting and silviculture will take place. To accomplish this, the data from the G.I.S. has been used to create an area stratification that quantifies each stand type throughout the limits. A set of yield curves have been generated based on an extensive forest development survey which is linked to the map base. The exercise of developing these inputs for forest modelling would have been impossible without a G.I.S.

The compiled data is used as input to the Foreman model. The results of the model indicate which forest classes should be harvested and at what time based on minimizing loss. The system has been used to assign a class type to each stand on the license area and to plot out 120 colour, harvest priority maps. These maps indicate by colour code the optimum time to harvest each stand based on the Foreman model results. With these maps, our operations staff are now laying out the actual cut blocks for the next twenty-five years, the first five of which will be binding.

A brief mention of some of our other G.I.S. projects would include: an automated procedure of the annual operating plans which uses data generated from the G.I.S. map updates, a series of land use commitment maps outlining sugarbush leases, deer wintering areas, and riparian zones, 1:125,000 overview maps, and recently, a budworm susceptibility map project. Other projects not mentioned here affect the day-to-day work of the field forester and are a separate topic in themselves.

PROBLEMS

The story of G.I.S. at Fraser is not just about successes. There has been a chronic problem of underestimating the time and manpower required to undertake projects on a large land base. The overruns in this area have been caused in large part by the time spent in data verification and map error checking. One such project was our E.S.P. study and mapping. This project tried to give a percentage value to the area excluded from normal forest management due to deer yards, and stream buffers. The number of inputs and problems of overlapping constraints extended the project well beyond the originally planned two months.

Another problem has been the development of our silviculture history record system. This involves an automated process for entering data and producing reports from the various surveys on plantations, cuts, and regenerated areas. To develop a system that links all the data on a stand's history in an efficient manner is a major design and programming problem. This fact coupled with some untimely staff changes has delayed the system's completion two years past target.

STAFF REQUIREMENTS

The last topic I want to emphasize before conclusion, is the subject of adequate staffing. There seems to be a developing trend to understaff new G.I.S. installations. There have been major advances in the technology, hardware is predictable and the software more user friendly. This has given rise to the notion that G.I.S. is a "turnkey" technology, it is not! Requirements have changed, it is no longer necessary to have a programming staff constantly fixing bugs in the software or to spend large amounts on hardware repair or computer downtime. There is, however, an even greater need for people who can take an idea and turn it into a workable G.I.S. project. This involves communication skills, design ability, and programming experience. Data input for G.I.S. is time consuming, the quality of the maps and data base is dependent on consistent error-free input, adequate staff is needed.

The great unknown factor in trying to determine the best number of people for any given G.I.S. is new development. Be assured that as managers, foresters, and technicians use the G.I.S. products, they will come up with applications unforseen at system startup. Also, as the technology advances, new projects will become possible. To ignore this potential, will erode confidence in the G.I.S. and limit its effectiveness.

The vendors of G.I.S. must be especially aware of this potential problem. The pressure to be lowest bidder does not overshadow the basic needs of a system. When a government department or private company looks to G.I.S. for solutions, they should be aware of how many people it will take to turn the keys of a "turnkey" system. G.I.S. is a technology that provides better resource management tools, it does not replace people!

CONCLUSION

These potential pitfalls do not lessen the many benefits of G.I.S., rather, they are areas of concern which must be addressed. The G.I.S. at Fraser has been and will be a solution to our management challenges. Without the technology, we would not have been able to manage our forest resource given today's constraints. Our particular system, the people, the hardware, and software have accomplished what we have asked. There are many new areas of resource management where G.I.S. will be applied. Given the commitment, innovative solutions using these systems will continue.

PLENARY SESSION V - "IMPACT OF GIS IMPLEMENTATION"

Daniel Lemkow
Vice President
Digital Resource Systems Limited
Nanaimo, B.C.

IMPLEMENTING GIS - STAFF TRAINING

ABSTRACT. Training for GIS involves the understanding of many disciplines. The form of training must be tailored to the various types of users. The program must provide adequate time for learning the concepts using a pilot project familiar to the users.

INTRODUCTION

Being a fast-growing software development company, specializing in GIS solutions, has forced us to recognize the need for proper client training. Besides keeping client satisfaction high, training has become our best method of reducing our support costs - a sort of "preventive maintenance".

Dealing with a wide variety of clients has given us a firm understanding of the "dos" and "don'ts" of GIS training. Unfortunately training is one area that organizations feel most tempted to cut corners. Training is more than a one-week intensive course; that approach, although cheap, rarely works. It is the intent of this paper to outline the important points for implementing a successful training program.

DEFINING THE NEEDS

Three components must be understood before designing effective training programs:

- The skills demanded by GIS
- The type of GIS installation
- The types of users within an installation

Skills demanded by GIS

GIS training can only be effective if GIS principles are well-understood. If one examines a generalized view of the GIS model, it is apparent that there are many facets - each requires markedly different skills.

GIS Model

Maintenance	Digitizing
	Map drafting
	Legal survey compilation (COGO)
	Photogrammetry (stereoplotters)
	Attribute data compilation
	Import from other GIS
Data Base	Graphics and attributes
Analysis	Map production
	Query
	3D modelling
	Tabular sorting/query/statistics
	Numeric modelling (spreadsheet)
	Notification (word processing)

The above indicates that skills are needed in drafting, cartography, stereoplotters, data base programming, spreadsheet, word processing, survey compilation and more.

Such an individual is rare indeed!

The Type of GIS Installation

The types of GIS installations can be broadly grouped into four classes:

APPLICATION SPECIFIC

The GIS is being used for a single application. Examples would be a forest company or a municipality. The data base design is static; the project will keep its basic definition for years to come. The set up of the system, and possibly the initial data loading, may well be done by a consulting company.

CONSULTING

The GIS is being used for a variety of clients. In each, the data model and problem being solved is different. A strong understanding of data base design is necessary.

EDUCATION

The GIS is a SMALL PART of the total education process. The goal is to introduce GIS concepts - not how to run a particular vendor's package. It can be difficult for teaching staff to find the time to fully understand all the necessary components.

RESEARCH

The GIS is used for many small projects that typically involve a lot of integrated modelling. The GIS technology is often being pushed beyond the design limits.

The Types of Users within an Installation

Within an installation, there are needs for three general skill combinations:

TECHNICIAN / PROFESSIONAL

Responsible for using the system on a day-to-day basis. The system has been set up and managed by others. Functions would range from digitizing to query analyses.

SYSTEM DESIGNER / ADMINISTRATOR

Responsible for the set up and management of the system. A general awareness of all facets of the GIS is needed with a strong understanding of the application data base.

APPLICATION DESIGNER

Responsible for the development of software modules for maintaining the data base; examples include developing validation routines for the entry of the attribute data and modelling functions.

The Training Program

The specific training requirements will vary greatly depending on the application. What follows is based on the assumption that the individuals already understand the underlying concepts. For example, a technician entering survey data already fully understands surveying principles.

TECHNICIAN / PROFESSIONAL

[on-going]
- mechanics of general system use (computer, operating system, general housekeeping).

[2 day workshop]
- introduction to graphics. Graphics is a good starting point because many of the functions are handled through an interactive graphics environment. Graphics is typically quite a novel and interesting environment for most novices. In addition, people EXPECT graphics to be the centre of the universe - it isn't, of course, but hopefully that will be realized by the end of the training program!
- establish a small pilot project to be used as the basis of the training program.

[1 month]
- trainees work by themselves on pilot.

[2 day workshop]
- review problems of the first month
- introduce importance of the textual attribute data - the other half of the universe; use polygon management as the example.

[1 month]
- trainees work by themselves on pilot

[2 day workshop]
- analytical functions

[1 month]
- trainees work by themselves on pilot

[1 day workshop]
- review of concepts and problems

SYSTEM DESIGNER / ADMINISTRATOR

Preferably the same as the technician plus concurrent instruction in:

- spreadsheet; basic techniques
- attribute data management; simple data management including entry and reporting shells

- word processing

The key concepts to be learned are:

- where does each tool fit in the GIS picture; and,
- the types of problems that can be solved with each tool.

It is not necessary or desirable to become an expert with each tool. Remember the saying "80 percent of the problems can be solved by mastering 20 percent of the techniques". It is also important to realize, especially in an application environment with a relatively static data base, many of the needed, ONE TIME, skills can be best obtained by retaining a consultant.

Where does one get such training? The community colleges are excellent sources. Application-related workshops and books round out the training. Books by QUE, SYBEX and OSBORNE on topics such as data base and spreadsheet are well written and easy to understand.

APPLICATION DESIGNER

Again, an overview of the technician training as well as solid instruction in programming. Programming skills are best obtained through formal programs at the college and/or university.

SOME OFTEN OVERLOOKED BUT APPROPRIATE CLICHES

In general, what are the keys to success?

These may sound like cliches but are unfortunately often overlooked:

1. A commitment by all staff, especially management, to the project's success.
2. Allocation of adequate resources. The unfortunate philosophy is often: "We'll have Joe learn the system in his spare time". It never works.
3. Maintain a high project profile. A little pressure always helps.
4. Start the training on a meaningful pilot project. This allows users to see and feel comfortable with the entire project.

5. Establish clear, attainable project goals.
6. Understand the skills and job requirements of the trainees.

SUMMARY

Training people for GIS is not a simple task because of the diversity of skills needed. To design an effective training program, it is necessary to understand the application, the users' current skills and the GIS model. The training should allow enough time for users to learn by actually using the system. Training is a key element in a successful implementation - it is not a place to save money.

John Finlaison
Director
Renewable and Administrative Systems Branch
Automated Information Systems Division
Alberta Forestry, Lands and Wildlife

SYSTEM MAINTENANCE[1]

I have been involved in computer systems for a number of years now in the area of operational systems. When you have a GIS that is operational, and your business becomes dependent on it, you have to manage that environment in a significantly different way from the research and development type environment you were in when working towards this operational GIS.

You've had a number of sessions already on GIS state of the art presentations and the leading edge is in the business. I guess what I am talking about is seen as more mundane but nevertheless very important housekeeping functions surrounding the computer systems. Hopefully, I will able to explain why systems people, people who maintain the systems, do the things they do and to many of you as users, they must seem like roadblocks, and I want to explain some of the reasons for those roadblocks.

The resources that look after the maintenance of our computer systems is consuming more and more of our available resources. The industry average is 70% of available systems resources are dedicated to maintenance and because of that it is impeding business growth by inhibiting the development of new GIS techniques and opportunities because all you people are spending the time in the computer departments perhaps working on the maintenance of existing systems. What we have to do is to maximize the effectiveness of the systems department while minimizing the costs.

As a specific theme for this talk, I have borrowed a phrase from a consulting company in Calgary, who do software maintenance consulting and the theme that they sell their business on I guess is that 'good maintenance is good business', and I want to elaborate on that theme.

As far as good business is concerned, systems that get approved for development and for you to spend your time working on, they're approved on the basis of feasibility studies or cost benefits or cost justifications - whatever you like to call it.

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[1] Note: Paper transcribed and edited from tape.

At some point, there is some statement of what the benefits to be realized from the development of the system, what the benefits are going to be. As far as I am concerned, good business is making sure that you realize those benefits once the system becomes operational and that you continue to realize the benefits over a number of years.

It's also good business to be able to adapt to changes in the way you do business, the changes in technology and in fact, extending the effective life of those computer systems that you've spent money developing. It's invariably cheaper to extend the life by changing the system than it is to rewrite the systems.

So if that's the good business that we are after, what's the good maintenance that we have to achieve in order to satisfy that good business objective, and I would like to suggest an objective of what the systems maintenance people are trying to achieve for you, is to ensure the computer system is available when you require it, that it works correctly and that it provides accurate information. Achieving that goal, I guess, would be simple, - "if the system works, don't fix it" - that's obviously unrealistic.

So we are continually having to introduce change into the environment and it's change that is the de-stabilizing factor in computer systems, so in order to achieve the objective of systems availability, you have to manage the change environment to ensure that the system is available and that it works correctly and is accurate all the time.

The first step in managing change is to protect the production environment, and by that production environment, I mean the access to the physical computer itself, the access to the software and the data files - that has to be limited. You have to make sure that there are timely backups of all data and software to ensure that should something happen you can always recover, but basically protect, the idea is to protect that environment and only introduce change to that environment in a controlled fashion.

Change in itself in a more software sense, has to be managed by some sort of change control process. Changes should be planned and thoroughly researched and costed - I guess just like a new development, you have to almost do a cost benefit of every change you want to make. I believe it really applies to the more significant ones, but nevertheless, there's got to be some reason for making the change and they have to be approved. The changes have to be worked on in priority sequence, it may sound obvious, but we've found that it's not always the case that you work on the most important thing first. Wherever possible, changes to a particular system should be grouped into logical releases, like vendor's release software with which you are all familiar.

The changes from the technical point of view, even during the development are managed through all the stages of the system's life cycle like you would manage a new development. That means they're analyzed a design program testing - all the stages are followed, they just happen to be in a smaller way.

Finally, before implementation, any changes or package of changes should be thoroughly tested and approved by you people as users, not by the systems people saying "well, we've tested it pretty well, it can go into production", it's got to be you people who approve and agree to the implementation of changes.

To make this most effective in managing the computer system as the end users and the systems group, is to have a single point of contact between the two areas, we find the biggest time-waster in the whole environment is the poor communications that can occur if you have a number of users requesting a number of different analysts to make changes on the same system. So to avoid that, you have a user designated who is responsible for the planning and priorizing of the changes and you have a single systems analyst who is responsible for the actual technical delivery.

There are several things you can do as users to influence the effectiveness of the systems area. The planning is probably the main one. It's essential that you be in a pro-active mode with your planning and that the situation where you are making and then unmaking and then remaking changes is avoided and that can be done with good planning.

The next thing I would like to elaborate on is grouping changes into logical releases before, the technical people can be much more effective if all the changes for a particular program or a subsystem are pulled together into one group so they have to relearn that part of the system only once and not jumping in and out of the program every time just to make individual changes. The main benefit to releases for yourselves as end users is that you are introducing a new system to your staff who are working with the computer in a managed way. Say you release once every three months, so they don't have to relearn the operation, relearn the business every few days. They relearn the major change you've put in, and get comfortable with that, you iron out all the problems all the bugs before you go in and lay a change upon another change.

Testing is probably one of the most important aspects of managing change. Systems people will always tell you that they have unit tested, they've program tested, they've linked tested or system tested what they've done, but that's not the real world. The only true test is for you to set up a test in your operational environment to prove that the changes have been done or the changes you requested are working correctly and we call that a user acceptance test. I guess it could be called many things, but it's your call when that new software release is working and it's your approval to implement.

It's also reasonable, especially if you use outside private sector resources to do your changes for you to have a warranty period following the implementation of a new release of software. We typically have at least three months of guaranteed performance of the product that has been developed.

What I have said about software changes equally applies to hardware changes. When one of your technicians or consultant tells you that just changing this chip or changing this board in a micro or going to a new software version will be trouble-free and transparent, in an operational environment, don't believe it! You have to be prepared to test those source of changes to the operational environment as much as completely new redesigning parts of the software.

A quick word about GIS and packaged software. A lot of what you buy from vendors is not custom code, it's code that's already been developed by them and the big advantage of that is that you'll continue to get releases of that software from the vendor. So it's important that you don't customize that in such a way that new release can't be easily integrated into your environment. So if you have to customize any packages that you buy from the vendors, make sure it's external to the package itself, so any new versions can be slotted in with the minimum of impact. What you want to avoid is getting tied in to a situation where you can't afford, because of the cost, to implement new versions of the software.

I guess one word of caution in all this - these practices that I talk about, revolve around formal rules and procedures and it's essential that you apply these rules to the systems that are absolutely critical to the company. Don't apply them indiscriminately to systems that aren't of vital importance, because then the administrative overhead defeats the whole purpose. They're a good fit for non-operational systems, they're worth looking at as a guideline but not as an absolute rule. In short, you must be flexible and you must insist that your systems people are flexible too. Thank you.

Robert Morton
Forestry Consultant
Silvacom Ltd.
Edmonton

MANAGING INFORMATION: CATALOGUING YOUR FORESTRY DATABASE[1]

Good morning! As Mike has indicated, the topic that I am addressing here is "Managing Information: Cataloguing your Forestry Database". Addressing this topic, is a bit of a challenge on a day like this. It's the end of a long conference and unfortunately, it's a very dry topic. It has none of the sex appeal of the technology displayed next door. Perhaps though, it is a good opportunity now to sit back and take stock of the situation.

The perception is that information is starting to overwhelm us. New data is collected every day and tapes and diskettes are piling up in every corner across the nation. I think that it is essential that we learn to organize our information in order to ensure that it's working for us (not the other way around); we get the biggest bang for the buck that we spend on inventorying our resource; and, that we don't get too distracted to neglect the bottom line which, in fact, is to manage the forest resource. My message is simple and I intend to be brief. I suspect that much of what I will be saying will simply reinforce ideas that have been presented earlier and conclusions that you've already drawn. That being said, I will send around the issue of information itself.

Information is a resource. Lots of money is spent on capturing it and in order to maximize the benefit we receive from it, we must go through a process similar to the one undertaken when managing the forest. In other words,

- we should have an inventory of the information to know what we have, where it is, who collected it and when it was collected;
- we should develop a consistent plan for its use and distribution;
- and thirdly, we should learn how to manage it, in order to maintain the benefit of it.

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[1] Note: Paper transcribed an edited from tape.

DIFFERENCE BETWEEN DATA AND INFORMATION

In order to provide the context for a catalogue system, I believe it is important to differentiate between data and information. It should be clear what we're talking about here. Strictly speaking, data are the values physically recorded in database files. They are the characters, quantities that we enter. Information is the meaning of those values. In other words, information is what the data represents. Data, which is encoded information, is generated in many ways as we all know. It can be entered on the keyboard, scanned visually, etc. However, in all cases, the dollar value of that data warrants a proper inventory. Information flow in any organization is extremely complex. In this graphic[2], GIS appears to be the centre piece of the information system. In reality, many of the functions around the periphery of a GIS system compete for priority and there is a more complex web of communication than I have employed here. The point is that a GIS system requires constant attention. It needs to be fed and it is in constant contact with other functions that any organization or company must undertake. In addition, the activities that surround the GIS, such as the administration, updates, deletions, research into development of overlay models, remote sensing, digital input, inventory by sector - all generate data in and of themselves.

ARCHIVING AND CATALOGUING

To make the whole system work, requires a well-organized data archiving and catalogue system. Given the complexity and confusion that can occur, you start to wonder who's in charge and what kind of information system you really need.

So why should we develop a data documentation archiving catalogue system? Well, for one thing, data is sometimes very difficult to collect and the data itself acquires a special meaning to us when we have to brave the elements to collect it. Timber cruising can be an exciting time in itself.

Why develop and maintain a computerized cataloguing system? This is the meat of the issue.

- First of all, we have an incredible investment in the data.
- Secondly, a proper catalogue system will ensure
  - the ease of use

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[2] Note: The series of slides used in this presentation were not available at time of publication.

  - recall and updating of any data that we've collected.

- A catalogue system
  - enhances secondary use
  - makes data available to other users
  - minimizes duplication
  - reduces inconsistencies in the way data is collected.
- Standards can be enforced in data collection.
- Security restrictions, if appropriate, can be applied to the dissemination of the data.
- The integrity, in other words, the accuracy and cleanliness of the data can be maintained.
- Finally, but certainly not least, a proper catalogue system will facilitate data sharing and networking.

So how should we approach this question of developing a data archive and catalogue system? A catalogue system should contain only essential information pertaining to the data. Much of the information that is attached to any data file is, in fact, peripheral to a catalogue set up. As well, we must ensure that we're talking about standards in format and collection.

It is interesting to note where data is actually collected in an organization. There is a hierarchial structure and there are many parallels within government and industry. When we look at it, the primary collection and processing stage is at the activity level, which is at the bottom of the screen - Activity 1A and so on. Activity 1A, in this example, could represent timber cruise data collected within perhaps a measurement section, collected within an inventory branch, which would be within a forest management division.

Use of the data occurs at the activity, subject and branch levels, lower resolution data is required at higher levels. Consequently, data archiving cataloguing activities must be concentrated at the activity and subject area levels.

Based on our experience in information systems, I would like to present just a brief outline of one approach to developing a catalogue system. There are three main components in a catalogue

- First is the Basic Information, which includes information on who, what, where, when and why the data was collected.

- Secondly, Variable Format. In other words, how the data is organized in the database.

- Third, is a Data Dictionary - what is the meaning of the pieces of data.

I'll go through each of these components:

Basic Information would then consist of items such as the following:

- file name

- owner/agency or company

- location where the data was collected and where the data is now residing

- taper disk number or volume

- project number

- department

- file type, and so on.

Subject categories in this list are necessary for cross-referencing with other data types. As well, in certain cases, a data catalogue could contain information on associated publications and comments and warnings that may be particularly related to how the data was collected.

Variable Formats - The second part of a catalogue consists of the Variable Formats. In other words, how the data file itself is organized. The Variable Format consists of:

- record type

- variable number

- variable name

- columns

- field type

- decimal places

- precision and so on

This is very similar to the manner in which a database file is organized.

Data Dictionary - Lastly, a data catalogue should contain a Data Dictionary, which is really an enhanced explanation of what is included in the database. A Data Dictionary consists of:

- variable name

- code value for non-numeric variables

- definition of those values (an example might be a database where you had position on slope as one of your variables and the codes might be 1 through 10 - you need an explanation for each one of those codes.

Those are the essential components of an archive and catalogue system. The documentation and archiving system can be then embedded in a series of database programs for data input, editing and querying and that's basically it. It's a simple message but it's an essential component of any information system.

In summary, it's my opinion that many tangible benefits will be realised through proper computer file archiving, documentation and cataloguing. Thank you very much.

QUESTIONS AND ANSWERS

MICHAEL HEIT: I have a question to the panelists. As you may or may not know, I am a manager and most of my time is spent on hustling funds. It's very tempting when you are hustling funds, such as for a GIS, to concentrate on the capital aspect of the acquisition because that's the most focussed and that's the most immediate and it is tempting to downplay the maintenance and training that go along with an acquisition. I was just wondering, John, in your system, how are you tied into the acquisition of equipment, since you are going to be "carrying the can" for the maintenance of it?

JOHN FINLAISON: I guess, acquisition of equipment is part of the original feasibility, the economic feasibility perhaps, as well as the technical, but if we're talking economic feasibility, the actual purchase of hardware and software as well as the programming effort is part of the cost benefit and we factor it in that way. We influence it again, as I said, by standards, and we like to stick to things we know, because in the long run, it's cheaper to look after them, but the cost of equipment is just one of the items on the cost side of a cost benefit analysis.

MICHAEL HEIT: Over time, is there a tendency, I mean, have the estimates of how much maintenance and training that a systems acquisition takes, is that usually underestimated or overestimated?

JOHN FINLAISON: Training, as Dan says, is very frequently underestimated. I think that's one of the things that tends to get left behind in the excitement of creating a new system. What was the first question?

MICHAEL HEIT: And maintenance of a system?

JOHN FINLAISON: It is very difficult to predict actually. What we do when we're doing a cost benefit for a new computer system is, we just take a figure that is based on our experience over the years, of something between 20 and 30%, and we vary that depending on the complexity of the environment, the development cost will be your ongoing cost of maintenance. Obviously, maintenance peaks in the first year or two after implementation and then levels off, in fact, hopefully goes down for a number of years as you build expertise, as you get out of that mode of making changes to the system, hopefully you have made all the changes you can think of by then. But there does come a time where systems get older and the maintenance starts increasing and that's probably the time where you start thinking about rewrites.

MICHAEL HEIT: Dan, would you want to comment on that?

DAN LEMKOW: Well, I guess a couple points. One certainly on the maintenance side, from the vendor's standpoint. When we start talking about costs, part of the client typically seems to balk at us wanting to pay a maintenance fee for a year. They don't seem to appreciate that there is a charge and a cost and an energy associated with keeping support and the system running and that tends to be an area that does tend to be left out.. People will say "Well, that's OK, I won't take a maintenance program, I'll just stay with where I am". That's on the one side.

On the training side, one thing, but it's something I did forget to mention, is that Canada Employment has a very generous support program for specially consulting service bureau-type companies and also corporations for staff training. That includes things like course workshops, charges for consultant's times, for doing the training and even wage subsidy for employees, so that it is quite possible to get some fairly generous funding through Canada Employment to help soften the blow of the training cost.

MICHAEL HEIT: Any questions then from the floor?

MICHAEL HEIT: OK then, If I can just summarize that the three components that we looked at today for systems for GIS implementation were data cataloguing, maintenance and staff training. I think these three components are very important to GIS implementation and people who have already implemented realise this. As I said, these components are probably underestimated by people who are going into the GIS acquisition and I know as a manager I have underestimated them on occasion.

However, I'll also comment on the data cataloguing issue and I will comment on my own agency on this. At Canadian Forestry Service, which is a fairly old and established organization, we have good systems in place for filing all our hard copied paper. We have a central registry and it's got a whole coding system on it and we have a good coding system and cataloguing system for our library, but I'm not sure we have a good system for cataloguing our data and in a sense, this is somewhat in limbo. This is done usually by individuals and is tied into individuals and when individuals leave, that's where we have our problems, but with Bob's help we're just starting to change this.

SESSION V - "IMPACT ON THE FIELD FORESTER"

Adolf Kokoshke
R.P.F. Forester
Slocan Forest Products Ltd.
Clearwater Division, B.C.

HOW A GIS AFFECTS THE WORK OF A FIELD FORESTER

ABSTRACT. The introduction of a geographic information system on a microcomputer allowed inventory update and recalculation of the AAC for the company-managed TFL. The work load of a field forester includes a lot of reporting on the status of the land base. This reporting can be streamlined and made more consistent using the GIS. It can also replace the old HOCE cards. Beneficial features of a GIS are standardization of drafting and mapping function, as well as higher accuracy and productivity.

INTRODUCTION

As a British Columbian, this is my first stay in Edmonton and I have already updated my geographic information on this city. For those people not familiar with Edmonton, 'Sherlock Holmes' is a local watering hold: 221B Baker Street is two blocks down and one block over if you want to follow in the footsteps of this famous detective.

The Clearwater Division of Slocan Forest Products is comparatively small, operating on a Tree Farm Licence and a Forest Licence with a combined cut of 500,000 m3. A little over a year ago, we decided to join the 20th Century, and, after a week of search and assessment, acquired a GIS software - Terrasoft - and hardware to run it, at $41,000 of which $2,000 was formal training provided by the vendor. It took six months to bring it on stream and make it operational. The capital investment of $39,000 was expected to be written off within 3 years. Our expectations now are that it will be less than 2 years.

We have 100 maps in electronic form covering our entire operating area. In the previous re-inventory of the TFL, 33 maps had been digitized. The remaining maps were available in digital form from the Ministry of Forests and Lands, Inventory Branch. Along with the maps are the associated attribute lists or data bases which are now being expanded. Various reports and data for a new five-year management and working plan have been generated, as well as the basis for the AAC calculation. A forest profile requested for sawmill design was also generated. We have also applied Terrasoft to forest land outside our operating area in Wells Gray Provincial Park where no previous maps or data existed.

To ask me now to handcrank information, whether it be inventory or otherwise, is the same as asking a Bavarian to quench his thirst with water. It can be done, but very reluctantly.

EFFECT OF COMPUTERIZATION

Under the term GIS, I understand not only maps and associated attribute lists but also the peripheral features such as traverse calculation or traverse insertion and query - that is, asking questions. It is an information system for forest management that incorporates area control.

In assessing the impact or changes the GIS has made, it is sometimes difficult to differentiate whether the changes were due to the introduction of the computer per se or due to the GIS. The usual perception that a field forester has of the computer is no different than any other person's. He, or she, is intimidated by it and is very apprehensive of all the acronyms and polysyllabic jargon.

At the first introduction to computer aided drafting, the immediate reaction is one of awe when confronted with all that heavenly glory. It's like watching Katarina Witt in motion. To a forester, the computer people speak a foreign tongue where "byte" is not a chunk out of somebody's hide.

The computer people have coined the word 'fritter' to express the concept that COMPUTERS HAVE BEEN MASTERFUL AT WASTING USER'S TIME. The novices, especially, are bemoaning the time, FRUITLESSLY WASTED, in an attempt to make the computer do what it is supposed to do. The field forester sitting in front of a PC has not been excluded from this phenomenon. Long hours that infringe on evening beer drinking schedules, are a common occurrence until some proficiency is gained. Following this initiation period when fritters are less frequent, you can go into the publishing business and fill up the waste paper basket by quitting time. Productivity skyrockets, but the working day does not necessarily shorten. With the realization of the boundless opportunities of electronic information come the requests with equal lack of limitations.

That is what the introduction of the computer does.

WORKING ENVIRONMENT IN B.C.

I would briefly like to describe a forester's working environment in British Columbia. For the most part, the forest industry in B.C. operates on crown land under a number of licenses to harvest timber. Depending on this licence, the company usually assumes various responsibilities to manage the land. Every facet of operation is overseen from the field level upward, by the B.C. Ministry of Forests and Lands. Other than harvesting, most activities on the land are financed by the government through stumpage offset.

The government agency has seen an apparent need to pave an auditable highway with paper. Every project, whether it is cone collection, planting, fertilizing, or aerial photography, requires a formal proposal and documentation: there are six pages of forms for appraisal submission, five pages for Preharvest Silviculture Prescription, four pages for burning permit application, etc., and I am sure, well over 200 forms are listed in the silviculture manual. An integral part of this massive paper flow is the land base information who consistency is constantly under scrutiny. Reporting different hectares for the same area on different projects can erode your credibility. In a handcranking situation, land areas are elastic and only the eagles and the crows know what the back line looks like.

Separate from this reporting, the Silviculture Branch in Victoria attempts to keep track of the history of every opening or cut block. This central system relies on "fill in the blank" forms known as HOCE (History of Establishment) cards. To call them cards is a misnomer. They are three 8 x 14 sheets tacked together in an accordion fashion with a log of space for information. You should have no problem keeping track of your grandmother's birthday. There is no direct linkage to maps, and only openings and accessible disturbed areas are included. Some districts or licensees are better than others in keeping the system up-to-date. Others put the work on the back burner, especially during fire season. Since some of the information maybe outdated or incomplete, and with a turn-around time involved, the usefulness of the system to a field forester is suspect.

GIS AND ITS IMPACT

After using the GIS system for awhile, and when the possibilities of the system was realized, the reaction was quite positive: No more HOCE cards. We are planning to provide land data to the Ministry on paper from our database until electronic connection in the future. We are working towards standardization of maps and records to replace a variety of maps that exist at different scales and sizes and consolidating records from dispersed files.

Field traverse notes can no longer be ambiguous. The system does all the plotting so that the field crews supposedly spend more time in the field. Calculation of closing errors is done in a second, so now all traverses have to close within one percent. Time spent in calculations are shortened considerably. As I mentioned before, increased efficiency translates into a higher demand, and output is as reliable as the original information. Standardization of the maps and drafting function occurs, especially when pre-cut standard size paper is used for maps.

There are two functions in the GIS that I particularly like: One is the insertion of area from the graphics end into the database, the other is the query. In planning survival surveys, region surveys, broadcast burning or planting, you can ask such questions as for example: "Where are all the NSR areas?" Either on the screen or on paper it will show them in red, blue, indigo or violet at any scale you wish or on any precut size of paper! Accuracy and balancing of hectares provides more confidence in decision making.

The GIS has given a better and certainly a more accurate overview of the whole forest as well as a better picture of the wood supply. The expectation of lighting the information burden from the field forester has not materialized yet, but recent legislative changes (Bill 70 and the Subsidiary Agreement) are pushing towards it.

I enjoyed Dr. Baskerville's presentation. GIS is definitely the answer. All we have to do is ask questions and the present technology will let you determine your needs and find the right hardware/software combination. I don't think these are big challenging questions. What would be a big challenge? Here is one that springs to mind: Returning to the topic of Edmonton geography, on the intersection of Jasper Avenue and 100th Street, there are three banks. I think a bigger challenging question is how to build a brewery on the fourth corner.

Chris Bowers
Supervisor, Forest Information System
Fraser Inc.
Edmundston, New Brunswick

IMPACT OF FRASER'S FOREST INFORMATION SYSTEM ON THE FIELD FORESTER

ABSTRACT. The development of Fraser's forest information system has made a real difference to the day to day work of our field foresters. The system has meant more consistent, up to date information than ever before. The four major impact areas are the G.I.S. maps, district microcomputers, accessible database information, and electronic data collection.

G.I.S. MAPS

Fraser's Geographic Information System has been in place since the spring of 1984. The system's two main functions are long term management and operational mapping. This second purpose directly affects our field operations. Prior to G.I.S., our maps were drafted and updated by hand. The overall quality was poor, stand numbers were confusing, and area calculations only possible by dot gridding. As part of the G.I.S. start up, a new set of 1:12500 scale photos were interpreted and transferred to a base map of the same scale. The detailed inventory data was used to generate map stand labels and other symbology. The area of each stand was automatically calculated by the system and plotted as part of each stand label. The new maps are much more readable than previous series. Detailed legends make the maps easy to use especially for new staff and seasonals.

The stand numbers on the G.I.S. maps are based on the location of the stand. A four digit number is generated, the first two digits indicate the relative horizontal distance of the stand label from the top left corner of the map. The second two digits indicate the vertical offset. This referenced stand label makes stands easier to find even after several annual updates have been carried out.

MICRO-COMPUTERS

As part of our Forest Information System, three microcomputers were purchased for use in our district offices. In the past three years another seven machines have been added. The primary purpose of these micros was to distribute the G.I.S.

database information to the field staff from the central minicomputer. They also act as primary input devices for the various surveys carried out during the operating season. This function has greatly increased the turn around time between collecting the data and producing preliminary reports.

To accomplish both the data acquisition functions and the G.I.S. inventory accesses, the INFO database management system has been used in conjunction with some Basic and Fortran programming. This has resulted in a more user-friendly interface to the system.

G.I.S. DATABASE

The ability to access this data either at the district micro level or via requests to the G.I.S. directly has meant faster results and more consistent output. Some examples of common tasks will demonstrate this. One project involved some new bridge construction that was planned. The field people in charge wanted to find any tamarack stands on our 850,000 hectare management area which would be suitable for bridge timber. This request would have taken several days to complete by manually checking each map. Instead, the required criteria was entered on the keyboard and a search of the database started. The result was a printout list of map and stand numbers for stands with more than fifty percent mature or overmature tamarack. Approximately 100 hectares was listed and the entire process took less than one hour. Similar searches for red pine poles and cedar logs have also been completed. Listings for particular types in constrained areas such as steep slopes can also be produced.

This comparatively instant production of stand lists and area summaries means that the forester can undertake several searches, changing criteria, to produce a number of alternate reports in a very timely fashion.

DATA COLLECTORS

Fraser has been involved with electronic data collectors for the past three years. This process was in response to the need for error-free data collection and fast reports. The MSI PDT model 3 data collector is used. Presently eleven units are in operation with an additional seven units planned for 1988.

The basic operation of these units is as follows. A survey form is programmed using a Basic program development system. This program is "burned" into a chip that is placed in the data collector. When this program is started, the prompts for input appear on the screen in the same order as on a survey form. The survey is carried out with continuous error checking. Editing options exist to correct any bad data values. When complete, the data collector can be hooked to a microcomputer and the survey data transferred. At this point, the information can be printed, manipulated, or stored as any other data.

The first application for the hand-held terminals was at the Fraser tree nursery. The staff carry out daily seedling counts on sample multipots. Four separate counts are now done on the data collector, a seeding machine count, germination, overwinter damage, and a statistical count. These programs have been operational for the past two years and have saved a great deal of tedious labour. This has given the staff opportunity to analyze nursery performance not just collect data.

In 1987, the Fifty year survey and the Herbicide survey were automated. The fifth year survey is particularly detailed and the programming includes calculations for principal species, percent stocking, etc. With the present equipment, about one hundred and twenty plots can be measured per collector before downloading. A three-page standard report is generated from the data and the permanent files updated.

New applications are planned for the data collectors for this year. They include: a timber cruising survey, seed orchard survey, and a photo interpretation input form. In scaling, Fraser has been instrumental in the development and use of the Autoscaler collector used with an electronic yardstick. Three of these units are now in use with further acquisitions planned.

Some definite benefits have been realized since the start up of Fraser's Forest Information System. A distributed network for data input and information access is now in place. Our G.I.S. maps have improved the accuracy and quality of the field forester's work. The ability to ask complex questions and get fast answers means that more time can be spent managing the resource and less time consumed in collecting and compiling information.

Don Reimer
Consultant
DR Systems
Nanaimo, B.C.

HOW TO IMPLEMENT GIS[1]

My talk today will be to give you some of the benefits of our experience in implementing a GIS. First, we ought to back up a step before we talk about the GIS itself because one of the things that GIS systems require to be effective is good data and as most of you have heard from the speakers throughout the last two or three days, everybody sooner or later has spent a lot of time working on datasets. While we all know that GIS systems are expensive to buy, the software is fairly expensive and the hardware is fairly expensive, the value of the resource you are trying to manage is on an annual basis worth what it cost you to buy your GIS system. I think you need to step back and look at a GIS as part of a decision support system that's not cheap, but depending on how you look at it, it may or not be expensive.

DECISION SUPPORT SYSTEM

I believe a GIS system is simply one piece of a decision support system. A typical decision support system can be illustrated in this sort of a simplistic fashion[2]. Every organization has a series of goals and objectives they wish to achieve and those goals and objectives if you are a forestry oriented company or for that matter any land based resource company need to have some kind of inventory, you have to know something about your history or the silviculture treatments, so you have to have some kind of record system. You have to be able to develop that inventory forward in time to determine if you're managing your resource in a responsible manner, i.e. if you're running out of wood or not. This can be used for management planning since the results of the management plans are essentially tested against goals and objectives. The management planning side can be somewhat complex depending upon the degree of multiple resources that are involved and the particular limitations and complex state of the organization itself.

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[1] Note: Paper transcribed and edited from tape.

[2] Note: The series of slides used in this presentation were not available at time of publication.

When you put a GIS system in, essentially, it can become one of the key components of your data bases. It's essentially the data base that allows you to do the spatial relationships between different stands or allows you to handle the distribution of a resource because one of the unique features about a land base resource is it's distribution over an area. If you don't have to worry about the distribution of the resource of the area, you don't really need a GIS, everything else you can do with a data base management package. For most of the applications that people talk about, the GIS is really a supplement. It's sort of the sexy, jazzy piece of the application that allows you to get the attention for the application in the first place and also allows you to do the mapping part as well. To my mind, it's one piece of a puzzle.

RELIABILITY

As far as the reliability of the data goes, almost inevitably, in every project we have been involved in there are tremendous problems of getting the data in shape so that you can actually use the GIS for what it is meant to be used for. You invariably have problems with maps. For the last 40/50 years, everybody has been cheating in the odd corner here and there, as the first speaker in this session mentioned, the land base seems to be elastic. We also have, and most companies have, a huge pile of paper stashed in various file cabinets on forestry records. If you have more than one operating division, they're guaranteed to be in different formats, even within the same operating division, so you have to figure out a way to get that straightened around.

RESPONSIBILITY

What I have listed here are seven steps that we use when we help people to try and put something together. They are very simplistic in topic but there is a lot of work, sweat and pain on several of these. So what I want to talk about is in each of these steps, is the responsibility of the organization, the forester, the engineer, relative to what has to be done in each of these steps.

USER COMMITTEE

Now, when we put in the first system in MacMillan Bloedel, we actually started in 1976 with a micro-based engineering support system and we did some good work, I believe, and we got a lot of heat. None of the engineers were satisfied - there was always something that was wrong and it took us a year and a half to figure out that you have to get a user committee of the foresters and engineers, three to five people, and it's their job to decide what the formats or the data is going to look like and which attributes are you going to record, which ones are you going to store and which ones are going to be important. They have to go around to all of their other people in the company who are going to be the users of this information and come up with a consensus.

Once you do that, it solves a lot of problems, because those are the people who have the best chance of understanding what it is you really want to do. Now I say they have the best chance because it's been our experience that you're not really able to define what you want to do until you have one for awhile. If you haven't used a system, there are bound to be dozens of things that come up or little 'glitches' that you forgot to tell people and had never even occurred to you. So the selection of the user committee is important.

For those foresters who are on the user committee, it's a serious responsibility, it's a lot of work. For most companies, it takes between 25 and 30 actual meeting days to get things sorted out - that has been our experience. So if you are field forester and you are assigned to the user committee, it is a big chunk of time, because that is extra time or you have got to figure out a way to get released for that time. Most of that time is front-ended to the project, there needs to be some consideration as to when you want to actually start either a pilot project or a main program to load data and set up systems, etc. So most companies, I believe, would find it beneficial to start a project, select a user committee sometime in the late fall so you get the winter when it's slack in the field that you can actually spend the time in the meetings, go around and get everything defined.

PILOT PROJECT

The definition, the applications and the data base are primarily the responsibility of the user committee, whoever the person or the organization is that's putting things in place would have a fair role to play. My experience has been that it is best to let everybody put down everything they can think of, including the kitchen sink, and then you slowly pare the list down. When you have pared the list down, one of the best ways is to do a pilot project, that immediately does a couple of things. First, it allows the user and the supplier of whatever system you are going to use to actually get a good grip, or at least a handle grip on problems, e.g., with the cartographic quality of your maps and the projection system problems that you are going to come across when you start the systems for maps.

One of the things that they did in B.C., was when they went metric, they changed the map grid system and of course, that's just a stroke of the pen when you're thinking about it as far as cartography goes, but for most of the ministries who had already started a GIS system and in particular, I believe Frank Hegyi's, because he had a couple thousand maps in at the time, it was almost a disaster. The reason being, that we had to change the grids that the maps were in and you didn't really change the look of the maps at all because the co-ordinates were already there, but you had to cut and paste the maps because the systems were set up by map files, so that meant that you had up to nine pieces of maps, called up on the screen, stick them together, cut and paste them and put them back together, link new data bases, create new data bases. Well that's a whole new problem because up until that time, when you wanted to change a map base all you did was change a grid, then you get out the scissors, cut and paste, take some new photographs and away you went.

With the system on the computer, if you want to maintain the integrity of your data base, that's not a simple task. During the pilot project phase, you can find out about the kinds of problems that can arise and quite often, in B.C. for example, a lot of companies still have old maps on the old scale - the old system. They haven't converted it. So you have to go through the process of converting them, putting them on the new grids and the new map base. All of those little details, turn out to be tremendous headaches when you are trying to get something rationalized and put on a computer.

DATA BASE

The same is true on the data base side, almost everybody lists off dozens of attributes, out of those dozens, maybe even 100, there are probably 50 or 60 that are worth keeping. Out of the 50 or 60 that they really ought to have on the system, they probably got actual information on 10 or 20. So in the process of loading the data base some poor 'sucker' has got to go out and fill out all the old field forms that they didn't fill out before, or worse, he's got to go through all your records and get them standardized. Half the codes will be set in maybe some kind of alphanumeric code, half the codes will be in a numbering system, you may have changed stand numbering somewhere along the line. All of those are serious problems that you would have to fix before the system will work for you and almost always that work has to be done by the field forester on site, because he is the guy closest to the ground.

So then you do a pilot project, then you come to Step #4, where you are actually going to load up some of this information. Generally that depends on the size of the company and of course the size of the land base that you're looking at, but if you are doing something in the order of 1 million acres or so, just the process of going through that takes a minimum of six to eight months. So from start to finish now, you're very close to a year. By the time you get to Step #5, close to a year has gone by for most organizations.

INSTALLATION

Then comes the installation of the system and part of the installation of the system is, if you can, that's a good time to finally decide to buy the kind of hardware you want. If you buy the hardware earlier, at the selection of the user committee, or you could do it after the pilot project, inevitably, while you are loading graphics and attribute data bases, as time goes by, people think of new things that they want to do and the application changes and it never gets small. Literally, every organization we have done work for, they hardly get the system in when they have to upgrade it because they are doing a number of new things. We don't put out micro systems that have less than a 70 megabyte hard drive in them. I don't care how small your organization is, that's the minimum that we would agree to put out.

TRAINING

In addition, when you put the system in, of course you go through the normal training program, most people who supply GIS software have around a one week training program, some of them are up to two weeks, what we try to do is supplement that with some sort of 'hand holding' as the user gets up to speed - what we call the 'user education'. Normally, I would say (and other people can vouch for this) but I think that you are probably not going to be really efficient with that system for about three to six months and that's only if you have a designated forester or a designated person who spends a lot of time using it. The query side of the GIS is, I believe, very easy for field foresters or engineers to learn to use. The updates systems within GIS systems are very complicated and they're not something that a guy is going to walk in once every two months and do. You have to designate somebody who is going to look after this, who is going to do this at least once a week.

SYSTEMS MANAGEMENT

The last step I will get into is Systems Management. There was a gentleman this morning, John Finlaison, who talked about system maintenance so maybe he said some of the same things, but I will repeat them nevertheless.

DATA MANAGEMENT

Along with Systems Management comes Data Management. I think one of the big problems, or at least we are beginning to think that one of the biggest problems in actually making GIS systems work operationally, is that you have to address the data management side of things. So I think what needs to be done as part of the training is it's almost at the stage where you have to give the person who is going to be the technician in charge of this system some actual data management training. By that, what I mean is, you have a lot of files, you have a lot of expensive files, they are valuable and you have to start thinking about system security. You have your whole inventory and everything is on that box, depending on the organization and the sensitivity of that data, you have to address that fact. Who can get into certain files, certain layers of information, how do you back the system up? You are supposed to do daily backups. Most people don't do that, but you will after you have blown it twice, then you will do it. Then there is the question of handling upgrades. When are you going to do an upgrade? When are you going to do a hardware upgrade? When are you going to allow a vendor to give you a software upgrade? Those things have to be thought about and they have to be done at your convenience, not the vendor's convenience, because you don't want to go halfway through something, go through an upgrade and end up having to re-do the process.

So to a large extent, with System Management and Data Base Management, you have got big data bases and you generally make copies for management working plans and you inevitably make a copy of virtually the whole thing - that becomes your working copy. Well you can expect that if your data is in a 30 megabyte or uses up 30 megabytes of hard disk, you probably have four or five versions of that floating around. If you want to keep at least one of those on line, then you've got to have at least a 60 meg hard drive just to start. So data storage capacity for forestry applications or anything like land resource applications can get very expensive, I wouldn't say expensive, because disk storage is not particularly expensive - it can be if you get into the big disks but it's something you have to be aware of and you have to manage the system. It's not like just sticking in floppies and going away and carrying stuff off. There are ways to get around that. Some people have used back up systems with 20 megs; there is some new technology coming out now, we have one unit with us which has removable hard drives, which looks to me to be the kind of thing that might be a good application. They're a bit better than the laser drives because it's a regular hard drive. We have two 30 meg units and they have got 70 meg ones on the drawing board. So for a 70 meg unit, you can manage up to a million acres, so that becomes quite useful. You get a hard drive that you can just pop out and basically hang on to that and stick it in when you are ready to go.

My feeling is that step #6, which just says "System Management", is basically a whole new area that needs a lot of attention. That's the key to keeping this thing running. You've got to have fellows like Chris Bowers with a lot of hard sweat and a lot of hard-earned experience to make that happen for you, especially you need the benefit from those people when you are putting things out on micro-systems.

Thank you.

SESSION VI - "GIS AND THE FUTURE"

Isabelle Kneppeck
Consultant
Canada Centre for Remote Sensing

INTEGRATION OF REMOTE SENSING WITH GIS: CCRS APPROACH[1]

A GIS is essential for optimum use of remote sensing and effective resource management. Remote sensing imagery in its raw state may contain distortions caused by sine angle, terrain, image geometry, or the atmosphere. Image analysis systems can help to reduce or eliminate many of these problems, thereby allowing the user to continue on with training and classification of the image. In a system that integrates remote sensing with Geographic Information Systems, one could use the information in the GIS database, for example, the forestry data set, to help us understand what's happening in the satellite image, thereby allowing the user to obtain more precise training areas.

A GIS is an important source of calibration or training data. Information in the GIS database can be used to remove areas of ambiguity from the satellite imagery. Satellite imagery often does not have sufficient resolution to detect small objects such as creeks that are overgrown by forests, so information in the database could help us to find these particular areas.

Remotely sensed data is both a source end user of digital terrain model information. MEAS and radar are currently being investigated as potential sources of DTM information. Digital terrain data is mainly acquired from the Federal Department of Surveys and Mapping at 1:50,000 and 1:250,000 scale. DTM information is also acquired from the Defense Mapping Agency for our studies in B.C.

Basic characteristics of an ideal system include the single screen approach which was first demonstrated by the B.C. Ministry of Forests and Lands, where an image is placed on the screen and a forest polygon overlay is placed on to that image. With the user-friendly workstation, it would be possible to move between the image analysis and GIS environment and update manually with a mouse.

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[1] Note: Paper transcribed and edited from tape.

Now for some examples of CCRS projects[2]. Here we have a forest polygon overlay in red which is on Landsat 5 thematic mapper image, which was acquired on October 9, 1984 over an area near Whitecourt, Alberta. Bands 3, 4, 5 are displayed here as blue, green and red, respectively. Most of the area was burned by fire in 1972, the area that was burned was approximately 100 sq. kilometers. The objective of this particular project was to use two season thematic mapper transparencies to interpret the regenerating forest burn. Following this, results were entered into the ESRI ARC/INFO GIS, and image analysis such as contrast stretching was done with the ARIS 3 system. The pink areas on this image are clearcuts, the darker green are softwoods, the lighter green areas are densely regenerating conifers, the lighter green or yellowish areas are sparsely regenerating conifers, and the brown areas are dead standing timber or snags.

Here we have our second example. CCRS has been doing projects in co-operation with the B.C. Ministry of Forests and Lands, where multi-sensed data are used to extract forest cover change information and update forest inventory maps. In this particular example, we have a forest polygon overlay shown in yellow, which is on a Landsat 5 TM image which was acquired on August 15, 1984 for an area near Cranbrook, B.C.

The clearcut areas which run through the centre of this image are at an altitude of 1600 metres. The mountain ridges that are to the left of the clearcuts are at an altitude of 3,000 metres. The clearcuts range in size from 12 to 71 hectares and the forest species are mainly Lodgepole pine, white spruce and balsam fir. The ages of these stands range from 150 to 200 years. This example gives you an idea of the rugged terrain around Cranbrook and it also shows one of the clearcuts in the river valley.

Here we have a contour line information which has been overlain on the same forest test site. This contour information was obtained from the Defense Mapping Agency.

This is a perspective view of that same forest test area with no terrain correction applied. Image analysis was conducted with the Landsat Digital Image Analysis System (LDIAS) and the Intergraph GIS was used to manipulate the forest polygons. This image was constructed by using a 1:50,000 digital terrain model and combining image data with the forest polygons overlays.

This is a MEAS imagery which was acquired on August 20, 1986 for an area near Smithers, B.C. The objective of this particular study was to use MEAS imagery to assess the success of regeneration following harvesting operations. It's a colour infra-red image, the dark brown are mature conifers, the lighter brown areas represent a twelve year old coniferous plantation, the red areas are brush competition, the bright white patch in the upper left is a clearcut and the lake on the right hand side is Chapman Lake. The PAMAP GIS was used to compile and assess the results of this particular study and here we have an example of an output from the PAMAP GIS in the form of a colour-coded map, the green areas are sparsely regenerating conifers, yellow areas were conifers which were of good density, and the burgundy-coloured area is dense regeneration. All of the blue is a mixture of softwoods and hardwoods and the white are bogs and brush.

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[2] Note: The series of slides used in this presentation were not available at time of publication.

In the area of technology development, CCRS' greatest efforts have been in the development of the Landsat Digital Image Analysis System which supports experiments that integrate GIS with image analysis. CCRS has also been a lead agency for the industrial development of a close integration between the ESRI ARC/INFO GIS and the ARIS image analysis system. CCRS has also developed the ability to use the MEAS sensor to provide DTM data through fore and aft stereo images. They have also supported the industrial development of stereo cartography using the spot satellite.

Now I would like to ask Ko Fung, who works for the Methodology Section of CCRS to make a few closing comments.

(Ko Fung):

I would like to make a very short remark. I would like to say that CCRS, together with B.C. Ministry of Forests and Lands, have successfully completed in GIS remote sensor integration experiment, in which remote sensing data are used to help update forestry inventory map. The classification result derived at by using our own image analysis software, the PAMAP graphics equipment and Intergraph system equipment, have achieved over 85% of accuracy in the areas of burns, clearcuts and regeneration boundaries.

Yesterday, a speaker mentioned about the difficulty of a major Canadian remote sensing company. I am glad to inform you that this company now is back in operation and CCRS has acquired a system from them - delivery is expected within this year.

Finally, I want to emphasize that remote sensing is a tool to help you to do your job more efficiently. It helps to monitor a lot of areas in a more timely fashion. The success or failure of a private company does not diminish a bit the usefulness of remote sensing.

Vincent Robinson
Professor
Department of Surveying Engineering
University of Calgary

APPLIED ARTIFICIAL INTELLIGENCE AND THE FUTURE GIS[1]

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[1] Note: The Editor regrets that this paper was not available at time of publication.

Glen Jordan, RPF
Associate Professor
Faculty of Forestry
University of New Brunswick
Fredericton, NB

GIS APPLICATIONS RESEARCH

ABSTRACT. This paper examines Geographic Information System (GIS) research in light of its potential contribution to future application development in forest management. Specifically, the paper looks at applied GIS research being carried out at UNB's Faculty of Forestry and assumes that GIS applications research at other Canadian centres is of a similar nature. The paper begins with the suggestion that the first step in forestry GIS on the Canadian scene has been characterized by the creation of digital map-based forest inventories, map production and spatial database management. It suggests that only through applied GIS research will forestry GIS advance to the next step. The next step is described as the research, development and implementation of GIS applications that assist in harvest scheduling, harvest allocating, silviculturally treating, and protecting. The paper briefly describes several GIS research projects currently being conducted by graduate students in the Faculty of Forestry. These include: (i) riparian strip modelling, (ii) plantation potential modelling, (iii) harvest allocation and transportation cost optimising, and (iv) budworm spray block planning. The paper concludes with several observations concerning forestry GIS: (i) forest management applications will appear soon but forest managers will be slow to adopt them, (ii) applications will tend to rely upon a raster (grid) representation of map data as opposed to a vector (co-ordinate) representation, and (iii) new application will require the collection of much additional spatial data.

INTRODUCTION

The theme of this Edmonton conference - the next step in forestry GIS - is timely and appropriate. Foresters, at least in Canada, have been among the first to embrace GIS technology (1). In fact, the widespread adoption of GIS technology by provincial forestry agencies and forest companies has, to a large extent, legitimized the technology in Canada. Virtually every province has, or is in the process of acquiring, a GIS. It seems appropriate that foresters are assessing accomplishments to date and thinking about the future.

Accomplishments of the past 10 years represent a significant milestone-step in forestry GIS. This first step has been generally characterized by three activities:

(i) The creation of forest inventories using GIS technology.

> Typically, these inventories have been of provincial scope and have integrated, for the first time, both thematic and locational attributes of the forest in one digital database.

(ii) The use of GIS technology as a spatial database management tool.

> In a fashion analogous to conventional database management systems, GIS technology has permitted the computer storage, organization, management and retrieval of map-based information.

(iii) The use of GIS technology in automated map production.

> The application of GIS technology to date has emphasized the automated production and maintenance of forest cover-type maps.

In contrast, the next step in forestry GIS will be characterized by the application of GIS analytical capabilities in forest management and, by necessity, the expansion of existing GIS forest databases.

Only through focused research and development in the application of GIS in forest management will forestry GIS take the next step. This mean developing GIS applications in the four activity areas that permit foresters to control forest dynamics: (i) harvest scheduling, (ii) harvest allocation, (iii) silviculture/renewal, and (iv) protection (2). Here lies the greatest potential of GIS in forestry. Although there is little outward evidence, the necessary research is currently being conducted in some of Canada's forestry schools, government agencies and, to a lesser extent, forest companies. UNB's Faculty of Forestry is, for one, active in GIS applications research in all four forest management activity areas to some extent. The remainder of this paper will describe a selected research study in each activity area.

Harvest Scheduling

Harvest scheduling involves planning how much of what gets cut when and where. It is an extremely difficult task. How can a GIS help? Harvest scheduling is in part a spatial problem and it would seem, intuitively, that a GIS might therefore be able to assist.

A graduate student at UNB is developing a GIS approach that will assist forest planners in one aspect of the "Where?" question. The research does not address the harvest scheduling problem per se but rather addresses the problem of controlling harvest impacts upon non-timber resources - water, wildlife and recreation. Vegetation buffers - also known as riparian strips - are frequently left along water courses to control harvest impacts. Depending upon conditions surrounding watercourse segments, buffer widths vary. In some places, buffers may not be necessary at all. UNB research is developing a GIS modelling approach that will automate the prescription of riparian strips using digital map data. In fact, three separate, but related, cartographic models are being researched and developed: (i) a temperature model, (ii) a sediment model, and (iii) a visibility model.

A temperature model, as illustrated in Figure 1, will calculate a buffer that ensures water shade, and thus water temperature, is maintained at levels present prior to harvest. Given digital map data, the model will prescribe buffers of varying widths as watercourse orientation (aspect relative to sun), height of surrounding vegetation, and surrounding topographic relief vary along a given watercourse. The model uses GIS functions to perform three-dimensional geometry calculations involving sun zenith and azimuth angles.

The water sediment model, illustrated in Figure 2, will operate in a similar fashion. Buffer widths will be prescribed on the basis of surrounding slope (derived from digital elevation data) and soil erodibility. For example, a water course surrounded by relatively flat terrain and/or a heavy, less erodible soil type will be assigned a narrow buffer.

Figure 1
A Cartographic Model for Maintenance of Water Temperature

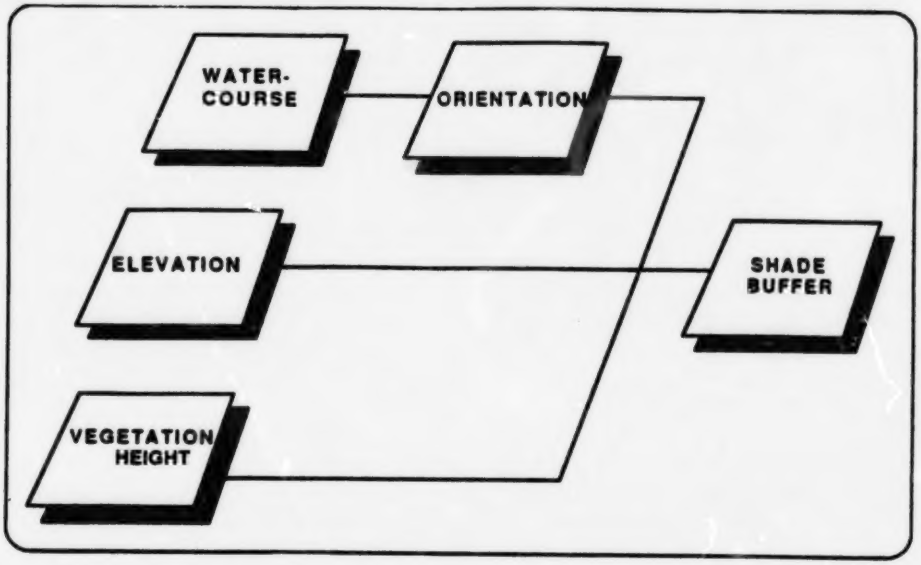
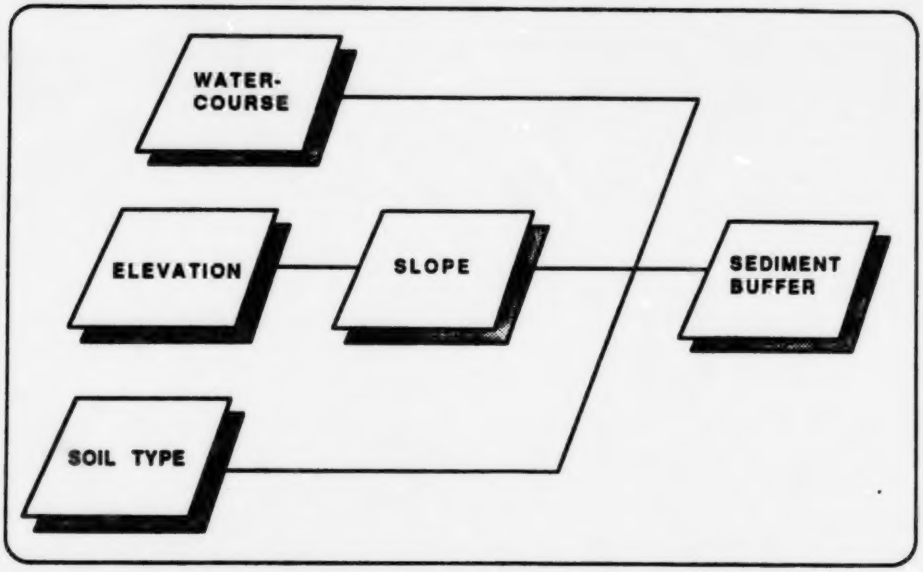

WATER-COURSE
ORIENTATION
ELEVATION
SHADE BUFFER
VEGETATION HEIGHT

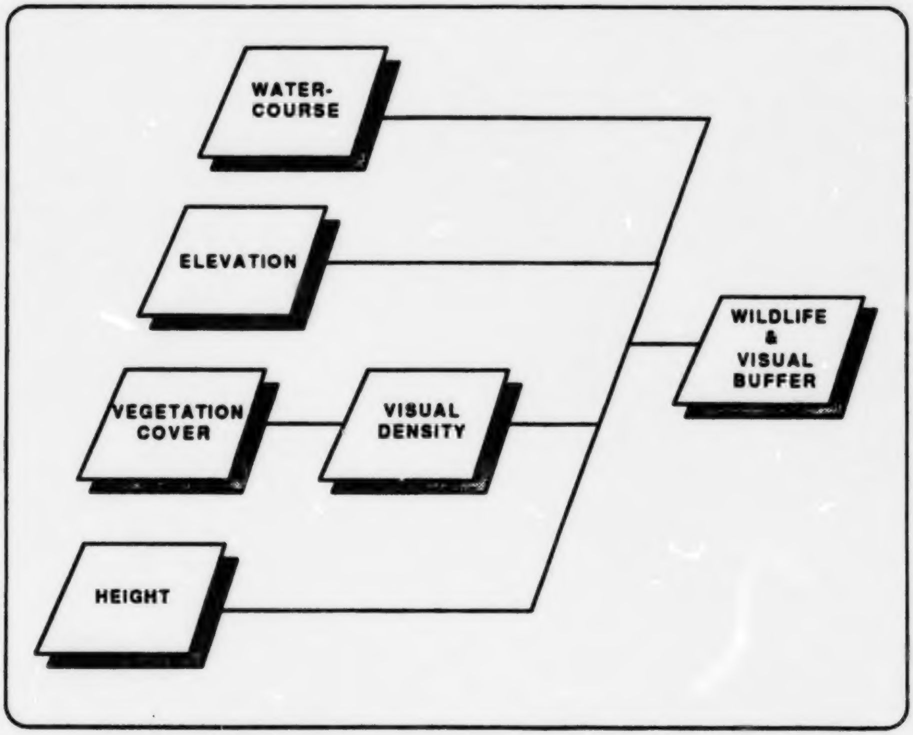
Figure 2
A Cartographic Model for Control of Water Sedimentation


WATER-COURSE
ELEVATION
SLOPE
SEDIMENT BUFFER
SOIL TYPE

Finally, a visibility model will prescribe riparian strips of sufficient widths to maintain wildlife hiding cover and visual quality from the recreationist's point of view (see Figure 3). The model will calculate buffer widths on the basis of surrounding topographic relief, vegetation height and a measure of visual density derived from a digital map of vegetation cover. Like the temperature model, this model employs GIS functions to perform three-dimensional geometry calculations. However, this case involves lines of sight.

Given appropriate site data in digital map form, these cartographic models will have the potential to facilitate harvest scheduling, namely the prescription of watercourse buffers in a systematic, site specific manner. In more general terms, the research will demonstrate the potential of GIS models as prescriptive tools in forest management.

Figure 3
A Cartographic Model for Preservation of Wildlife Hiding Cover and Visual Quality

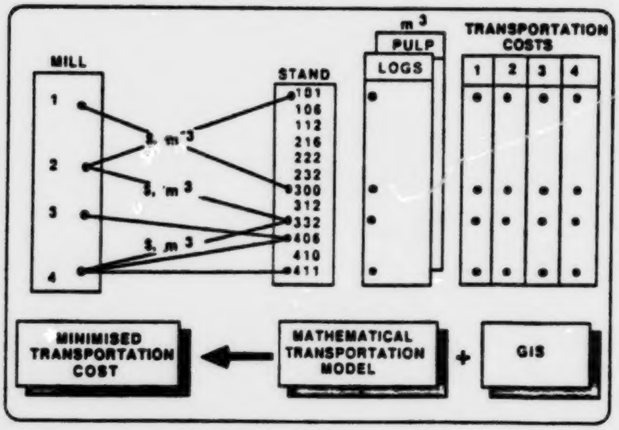


Harvest Allocation

Harvest allocation involves determining who (which users) gets how much of what from the harvest. In situations where timber quality is limited, harvest allocation is a difficult problem. In New Brunswick, this problem is compounded in the case of the larger companies who manage large Crown licenses. These companies must concern themselves not only with their own array of differing mill requirements, but also with those of a dozen or more sub-licensees. How might a GIS assist in solving the allocation problem? This question is being addressed by research at UNB. A graduate student at the Faculty of Forestry aims to develop a harvest allocation model (see Figure 4). The model will integrate GIS functions and mathematical optimising functions in a computer-based approach. This approach will be designed to assist forest planners in achieving the "correct" stand-by-stand allocation of the annual harvest while at the same time minimizing transportation costs. Not only will varying mill requirements be met but the allocation will be made so that hauling costs over an existing road network will be minimized. A GIS will act as data server, providing stand inventory data (m3 by product) and haul route distances/costs to a transportation algorithm which will make the final stand product-to-mill assignments.

The model is simple in concept, yet its impact promises to be significant. It is estimated that use of the model will reduce transportation costs by five to ten percent. In more general terms, the research is significant because it demonstrates a type of application involving the convenient marriage of GIS technology with another computer-based technology.

Figure 4
Schematic of a Harvest Allocation and Transportation Model



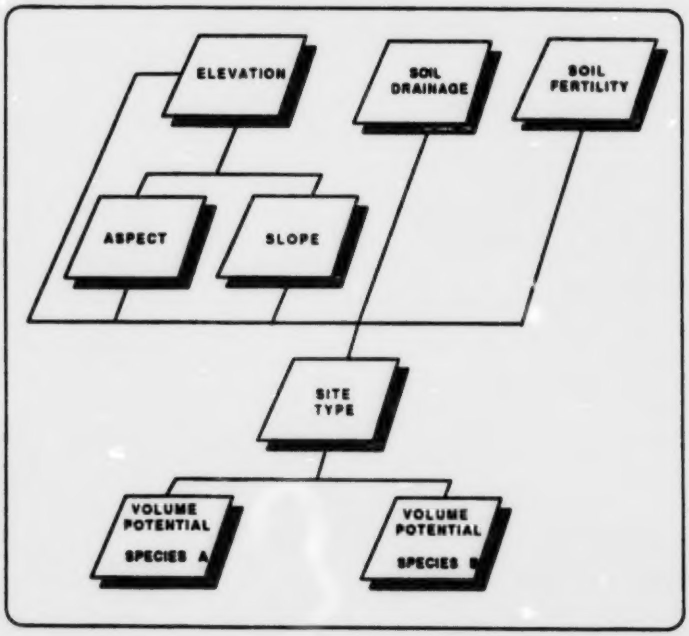
Silviculture/Renewal

Like harvesting, renewal is another forest management activity of considerable scheduling complexity. It involves determining how much of what gets treated when and where. Again, intuitively, it would seem that GIS technology might have the greatest potential in addressing the "where?" problem. A current research project UNB is investigating one possibility.

A graduate student at the Faculty of Forestry aims to develop, among other things, a GIS model of plantation potential (see Figure 5). It will assist forest planners in plantation prescription by calculating potential volume production for forest areas under management. The model will calculate aspect and slope information from digital elevation maps and then overlay these with digital map data of soil drainage and fertility to identify the various combinations in the form of a digital site type map. Plantation yield curves will then be used to produce volume-potential maps for various tree species.

The model will be capable of producing descriptive map products that will assist forest planners, constrained by funds and planting stock, in selecting planting sites with the greatest volume production potential. In broader terms, the research demonstrates another GIS modelling application in forest management.

Figure 5
A Cartographic Model of Plantation Volume Production Potential

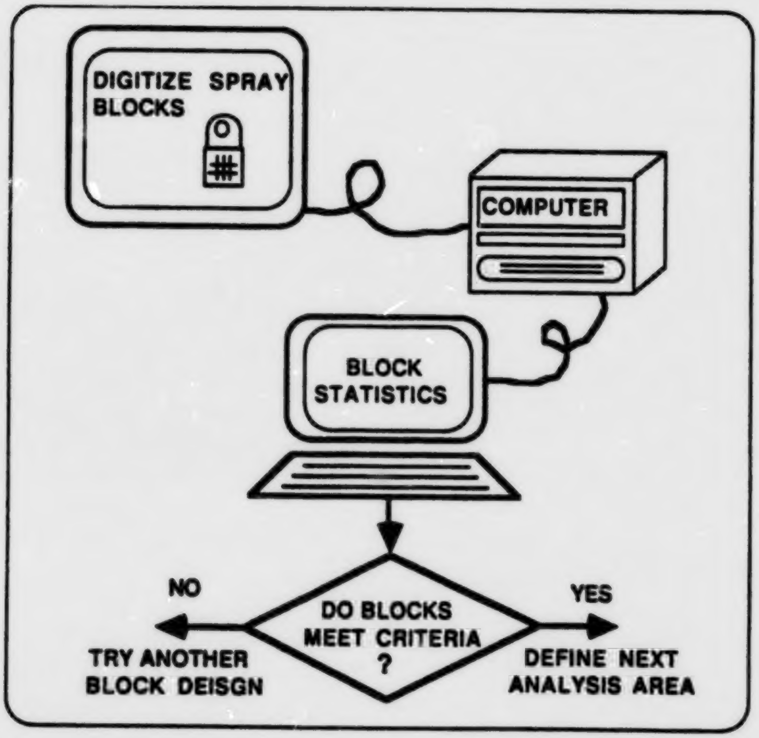


Protection

Forest management activities will be for naught if protection of the forest from fire, disease and insects is ignored. Protection involves determining how much of what gets protected when and where. How might a GIS assist? One research study at UNB is currently concentrating on this question.

Protecting eastern Canadian forests from spruce budworm is an undertaking that involves spraying thousands and thousands of hectares of susceptible forest each year. The utility of a GIS in producing maps which identify areas needing spraying on the basis of forest inventory and budworm survey data has been previously documented and is a well established procedure at New Brunswick's Department of Natural Resources and Energy (1). A graduate student research project at the Faculty of Forestry has taken GIS application a step further. The student has designed a GIS procedure that will assist in configuring and arranging spray blocks. It targets the maximum amount of forest needing protection while, at the same time, adhering to a host of legislated conditions and restrictions (see Figure 6).

Figure 6
Schematic of Spray Block Planning System (3)


DIGITIZE SPRAY BLOCKS
COMPUTER
BLOCK STATISTICS
NO
DO BLOCKS MEET CRITERIA ?
YES
TRY ANOTHER BLOCK DEISGN
DEFINE NEXT ANALYSIS AREA

The approach involves the interactive (real-time) application of a GIS to digitize and test spray block arrangement and configuration. A planner digitizes a spray block arrangement and configuration and then uses a GIS to overlay this on a digital map of susceptible forest and to compute a quantitative evaluation of the arrangement; for example, percent susceptible forest targeted, susceptible timber volume targeted and cost. The planner experiments with spray block arrangements and configurations until an acceptable evaluation is achieved. The research has demonstrated that a GIS has potential as an interactive planning tool in forest management.

CONCLUDING REMARKS

Applied GIS research, such as that underway at UNB, will provide the stepping stone for the next step in forestry GIS. This paper has described, in a superficial manner, a number of graduate student research projects underway at the Faculty of Forestry. It can be safely assumed that similar research is ongoing at other forestry centres across Canada. Although this research will soon lead to production forest management applications of GIS, widespread impact will be slow to materialize. There are many forest managers who do not yet fully appreciate GIS technology and remain fearful of it.

Discussion of the relative merits of grid encoding and processing versus vector encoding and processing of spatial data will continue in the future. However, as GIS applications come to increasingly rely upon analytical strengths of GIS technology as opposed to map production aspects of the past, grid encoding and the processing of spatial data will expand significantly.

Finally, new forest management applications of GIS technology, such as those described in this paper, will require a great deal of new and additional spatial data. Digital elevation data, for example, is one immediate requirement. This is a sobering thought for those organizations who have just completed time consuming and expensive GIS forest inventories.

ACKNOWLEDGEMENTS

I appreciate the co-operation of graduate students Bob Dick, Roger Roy, Leon Vietinghoff, and Rick Wightman in allowing me to use their research as a focus of discussion in this paper.

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Peter L. Senchuk
President and Chief Executive Officer
Alberta Educational Communications Corporation
(ACCESS NETWORK)

and

Dennis A. Thompson
Assistant Director
Resource Geoprocessing Services
Alberta Forestry, Lands and Wildlife

VSAT AND ALBERTA

(Peter Senchuk):

I am delighted to have been invited to participate in Forestry GIS with Dennis Thompson of Alberta Forestry, Lands and Wildlife.

The letters GIS were originally as strange to me as VSAT may be to you. For that reason, I asked that the title of this presentation be Alberta and Satellite. As the Geographic Information System (GIS) has become an important component of Forestry, the very small aperture terminals called VSAT has equally become a new, important component of the satellite technology.

The acronym VSAT refers to very small aperture terminals used for satellite communications. Unlike today's major uses for satellite services which point to multi-point for television, radio and other one-way transmissions, VSAT is interactive.

VSAT is the newest communications alternative to emerge using satellite technology. There is rapid movement into using VSAT and here's the primary reason. The cost savings possible with a VSAT network is as high as 50% over the cost of leased lines. It is estimated that by 1995, the market for VSAT Earth stations world-wide will reach 1.2 billion (U.S.)

It is predicted that VSATs will be designed to a cost level permitting viable use in the home as well as for extensive public and private applications.

VSAT systems are primarily used for interactive data communications but may also be used for voice and image communications. There is no single standardized definition of VSAT. There is substantial flexibility to design VSAT systems to meet a wide range of applications.

Within this presentation, I will outline a major VSAT filed trial that will take place in Alberta this spring. It includes many public and private sector partners. Alberta Forestry, Lands and Wildlife is a major partner in the project, and Dennis Thompson will provide details on their participation. Before we do that, I want to give you a brief overview of ACCESS NETWORK. Who we are, what we do and why we are involved in the VSAT technology.

ACCESS NETWORK is a statutory Crown corporation in the Province of Alberta.

The function of ACCESS NETWORK is to promote and assist in the development of lifelong learning opportunities for Albertans through the use of communications technologies.

To do this, ACCESS NETWORK provides support, co-operation, and leadership within a province-wide system of formal and informal learning opportunities.

The major functions of ACCESS NETWORK include the development, production, acquisition, and distribution of television, radio, print, videodisc and educational technology materials, including computer software distribution.

Since 1985, ACCESS NETWORK has utilized Telesat Canada's ANIK C-3 satellite for its distribution of the television service to satellite receiving systems at schools and to Cable TV households. The transponder bandwidth is also used to deliver our CKUA stereo FM radio service to 15 FM transmitters.

In addition to television and radio, we see such services as computer software, textual, electronic mail and data information to be distributed by ACCESS NETWORK via satellite.

As of last month, the ACCESS NETWORK satellite-based delivery system is providing a Night Owl Dubbing Service for schools. It's an easy to use, free service for educators to obtain video programs for classroom use and teacher in-service.

It's an early morning service following our regular television broadcast schedule featuring six hours of program downloading, five mornings a week commencing at 12:30 a.m. Educators simply pre-set their VCR's for recording programs. It became an instant success.

As in other areas of communications, the advent of satellite and cable has redefined the parameters of educational communications. The focus for communications service is on other recent technologies including data broadcasting, videodisc, fibre-optics, and the newest technology in satellite transmission "Very Small Aperture Terminals" (VSAT).

First and foremost, VSAT offers interactivity which is a vital component in distance education. Secondly, we seek additional uses of the satellite bandwidth with other users as a cost-sharing mechanism to make satellite transmission more cost-effective.

There are nine partners who will participate in the Alberta VSAT field trial. The field trial will be conducted for tele-education along with other public and private sector services.

The nine partners include: The Federal Department of Communications, ACCESS NETWORK, Four Ministries from the Government of Alberta, including Alberta Public Works, Supplies and Services, Alberta Forestry, Lands and Wildlife, Alberta Education, and Alberta Technology, Research and Telecommunications, Alberta Government Telephones, Microtel Limited and Nova Corporation.

The major common objectives of the field trials are:

(1) Investigate the technical and operational concerns of using the VSAT system and include the use of the band-edge spectrum of a television channel for space segment;

(2) Investigate the degree of two-way data communication capabilities via point-to-point/multi-point;

(3) Determine the economic viability of VSAT systems as an alternative means to serve metropolitan, rural and remote areas of Alberta.

Each individual end-user participant has its own particular objectives. ACCESS NETWORK is interested in the investigation of using the band-edge capacity of the ACCESS Ku-band satellite television channel on ANIK-C3 for the delivery of distance educational services. The Ministry of Education is interested in exploring new distance education delivery systems using VSAT technology and also to provide an opportunity for the teachers to experiment with new telecommunications technology.

The VSAT technology makes possible rapid interactive transmission of large quantities of information over long distances, distances, thus, become an unimportant feature of the teaching/learning progress.

Instructional experts have come to recognize that learning is not a passive absorption of content, but an active process in which the student learns through interacting with the instructional content.

I strongly believe VSAT has the potential to become a major component of distance education throughout the world, including developing countries which do not now have existing modern telecommunication facilities and resources.

The Ministry of Public Works, Supplies and Services (PWSS) is responsible for the operation of telecommunications and computer services for the Provincial Government. For the field trial, PWSS is coordinating the overall activities within Alberta.

PWSS is responsible for providing the interface between the VSAT system and host computers as well as testing of applications. PWSS also provides the necessary back-haul or local loop facilities for those host computers which are located outside PWSS operations.

The role of the Federal Department of Communications (DOC) in the field trial is to provide overall project management and the provision of a demonstrational VSAT system which consists of a non-redundant master control station (HUB) and remote VSATs at various Alberta locations. In addition, the DOC will provide technical expertise in the preparation of project plans and evaluation.

The Ministry of Forestry, Lands and Wildlife intends to use the VSAT system for linking remote field offices and mobile operation centres with headquarters for the data transmission of graphic and non-graphic information related to the development, planning and management of natural resources.

I am delighted to call upon Dennis Thompson, Assistant Director, Resource Geoprocessing Service of Alberta Forestry, Lands and Wildlife to present you with more detailed information in respect to their participation as one of the principal participants in the VSAT trial.

(Dennis Thompson):

The main reason we are examining VSAT communications alternative is because present land line technology is not satisfactory for transmission of computer graphics data, the VSAT satellite technology may prove to be practical. The field trial will determine what the possibilities are.

The project objectives of our Department are:

1. To determine the functional feasibility of the VSAT technology in the interactive transmission/reception of graphic and non-graphic data relative to the development, planning and management of natural resources.

2. To ascertain the comprehensive cost of installing and operating a fully functional VSAT network in comparison to other alternative applications for long-distance telecommunications.

3. To investigate the applicability of VSAT technology to mobile operations of particular elements of the Department, such as forest fire suppression.

It is anticipated that a multi-phase project can be implemented which would permit the use of remove up/down links to be used in department headquarters locations, field offices and mobile operations centres for the transmission of data and information relative to the specific application.

With respect to specific applications, it is anticipated that the majority of the project will involve the transmission and reception of graphic and non-graphic data. Examples of information to be included are maps showing current land use, resource coverage and distribution, and potential resource development plans along with appropriate attribute text.

Additional material to be transmitted will likely include daily correspondence and normal message traffic between participating offices.

That completes my remarks, and now it's back to Peter Senchuk for a resume on participation by the remaining participants.

(Peter Senchuk):

The private sector application of the Alberta VSAT trial is very significant. The Province of Alberta has immense natural resources of oil and gas. Our private sector partner, Nova Corporation of Alberta, has wide-ranging activities that include petrochemicals, petroleum, manufacturing, gas transportation, marketing, consulting and research.

Many of today's major corporations, such as Nova, find themselves relying more and more on electronic information gathering and exchange in their every day business activities. The increased competition, global markets and customer demands for more timely information is forcing many companies to review, in detail, their current and future voice, data and video telecommunications system requirements.

Nova Corporation has been involved in the natural gas transportation business for more than 25 years. Their main objective is to determine the feasibility and cost effectiveness of using VSAT technology as a means of linking remote meter stations, compressor stations, and field offices to central host computer facilities for the measurement, monitoring, control, and maintenance of a large gas transmission system.

Alberta Government Telephones (AGT) is presently operating a Microtel SPACETEL, thin route SCPC system for remote telephone application. The AGT support includes the permission to use their existing pilot system for the duration of the VSAT trial.

Microtel Ltd., which is the manufacturer of the SPACETEL DS2100 VSAT system, has a vested interest in the filed trial. Microtel is to provide maintenance, repair and technical support for the duration of the field trial.

The future for VSAT technology in Alberta looks very promising for public and private sector services. Its growth could be phenomenal if our field trials meet the expectations of the partners in this project.

Allan Levinsohn
Consultant
A. G. Levinsohn Inc.
Edmonton

CONFERENCE SUMMARY AND WRAP UP[1]

When Jake first approached me, it was suggested that the topic might be a step by step process in designing and implementing a Geographic Information System. I said that I wasn't sure that there was topic that could be covered in an hour and secondly, I was sure that over the course of the week, there were going to be many presentations that in fact were going to deal with all of those issues. What I would like to do though is to deal with some of the management-oriented issues and in the process that is becoming known now as Information Resources Management. This really means having a strategy for how you manage the information that runs your business. First, I would like to bring to your attention some issues and observations that were brought up during the week.

The concern for data quality came up on many occasions and I think it is a very appropriate one, it isn't enough to have the technology, but we have to have data in the system and we need to have good data. Related to this and to several other topics, was the business of cost effectiveness, we can't just afford to have a Geographic Information System for the wrong reason. I think one of the speakers said in one of the sessions, that we need good tools but we can't afford to have toys, and I believe that's absolutely right. We also need to determine our needs/priorities in order that we can do the things that are the most important and end up with cost effective systems, and related to determining the needs is the justification of those needs and at the bottom line there should not be any impact or negative impact in the cost of the delivered wood to the mill.

Data loading was identified as being the most expensive part of a Geographic Information System.

David Nystrom spoke of the importance of having a written GIS policy, stated objectives and goals of where you were going and it had to have top management commitment. He also spoke about co-operative projects that the USGS is doing and how they are finding that there is synergism in working with other agencies in sharing data and ideas and bringing together multidisciplinary teams, sitting around geographic workstations.

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[1] Note: Remarks transcribed and edited from tape.

There was a lot of discussion about hardware trends, the power, the fast graphics. Mainframe technology seems to moving towards mini-technology, and mini towards micro and all of them appear to be moving towards workstation technology. The cost is getting less and many people, Jack Dangermond for example, says they were moving towards zero cost hardware. I don't know exactly what that means - I am sure they're not going to give it away. On the other hand, I think what it does point out is that the concerns that relate to the expenditure of funds on the technology are far less than the concerns of data loading.

In dealing with the GIS database, we are dealing with complex transactions. What this means is we are not just talking about now and going in and doing "I hit on a single data item" and coming out and answering a question. We are not talking about going in and grabbing a single field, often we are doing multiple transactions on a graphics file at the same time that we are doing a transaction on an attribute file, sometimes on several attribute files at the same time that are multiply linked to the graphics data. Very, very complex actions are being done here.

Geography is the data integration tool. We have a lot of data that currently we can't bring together because they are disparate, unrelated data. They seemingly do not have anything to do with each other, but in fact they occur on the same parcel of land, the same place on the surface of the earth, and therefore we can use that as the basis for bringing together these otherwise seemingly disparate data.

Man/machine boundary. I think this is a very important one. What I am referring to here is where the activities of the human being stop and the activities of the machine begin. If you look at this as being a continuum from the machine doing everything to the other extreme, the man doing everything, somewhere in there is where we find cost effectiveness. If we try and build machines that are going to do absolutely everything and we design every application possible, we could invest millions or hundreds of millions of dollars on models and it would probably never be cost effective. On the other hand, going too far down the other way where the man has to do too much of the work, all you've really got is an automated drafting table. That's not going to be cost effective either. One of the big challenges we are going to have is finding where that boundary appropriately lies.

These are some late breaking observations from this morning's sessions. I didn't get a chance to type them up or do anything with them, so you will have to suffer through my terrible handwriting.[2]

It was addressed at one of the sessions this morning, that there were three underestimated components of a Geographic Information System:

- the data cataloguing

- the maintenance of the system once it's set up

- the cost associated with training.

Glen Jordan, in a session this morning, spoke about "The Next Step - What is the Next Step?". Forest management applications, that's probably going to lead to expanded databases, which brings us back again to the cost of data loading and cost effectiveness. We are going to need to resolve it if we are going to bring the technology into our businesses. He suggested a number of areas that might be candidates for forest management applications: harvest scheduling, harvest allocation, silviculture and protection. The four major programs that we are involved in as land managers. The way we would arrive at those applications would be through some form of modelling and that in itself, I think, is not entirely well understood yet and an area that probably requires significant additional research.

What I concluded out of all of this is it seems that GIS works. A number of people gave examples of it working: Chris Bowers talked about a system that works well; David Nystrom spoke of all of the systems at USGS. We know that the systems work in many other places - I don't think it's a question any more that GIS works, but what about the costs? GIS also costs! Costs vary significantly and what we need are strategies that can allow us to get the maximum return for our investment and reduce those front-end costs. Maybe one of the ways that we can do that is to share those costs.

In that regard, I'd like to talk a little about project design and implementation. In order to deal with this, I would like to compare in contrast, operation systems with information systems with decision support systems. What are those, what are the differences and do we implement the three of them in the same way?

I would like to then refer to managing change, because that's really the big issue. The technology as one component, databases are something else, but these are really technical issues. The whole process is related to managing change - we're talking about changing the way that our businesses operate, the way that we fundamentally manage the land base. What is the process for doing that? Within that context, I would like to speak a little bit about strategic planning and compare in contrast traditional user needs, and where do traditional user needs processes fit into this and can we in fact effectively do it?

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[2] Note: Slides referred to were not available at time of publication.

Then lastly, I would like to speak about cost and collective action as a mechanism for sharing some of those costs and reducing them overall.

Before I do that though, what I would like to do is go to the slides and just give you a very quick overview of one view of project design and implementation and some considerations in doing that. Don Reimer this morning spoke about GIS implementation and covered off some of these topics. For those of you who were in that session, I apologise for the repetition; for those of you who weren't, you'll find there is some degree of concurrence. On the other hand, there are probably as many different design techniques, structured design approaches as there are systems analysts and you'll find that there is a large degree of agreement and disagreement, varying amounts of that depending on who you speak to. Rather than give you a specific single process today and tell you "this is how to do it", what I'd like to do is just deal with some general considerations and general principles.

PROJECT DESIGN & IMPLEMENTATION

The objectives of doing project design and implementation or having a structured design process at all, are orderly cost control system implementation. By planning it and by knowing what steps we're going to be going through, we can schedule things such that the cost downstream were less likely to become blunders as a consequence of the cost overruns. What we are looking for then is lower maintenance and operating costs, satisfied end users (that's very significant - a system that works perfectly but doesn't do what it was designed to do or if no one uses it, it is of no value to anyone).

It's important to have a mechanism for change control and managing organization impact. We want to have a flexible expandable system so that as you identify new requirements there is a mechanism for adding those to the system, whether it's additional data or new functions, more workstations, whatever it is - it's important that you can upgrade so that you don't have to throw away what you've done. Good planning will enable you to do that.

We want to have an integration of applications and functions. What does that mean? That means that you have the equipment fully integrated into a work flow, where the computer is just one part of it - it relates back to this man/machine boundary that I talked about. You don't want the machine to be somewhere off on its own and not part of an overall process - you want it to be integrated. An earlier example of this is word processing, where the word processor sits on the secretary's desk and it's an integrated part of her daily functions.

We want to simplify system implementations so that it is understandable by management and the end users so that they can in fact provide the direction that is required to make it a successful system.

We want to have faster systems development because we need to get faster returns on the investments here and once management becomes convinced that it is a good idea, you get their enthusiasm up, they don't want to be waiting five or six years before they see any returns.

And of course, we want to have lower system development costs. That's perhaps the greatest objective of all.

What I have here then are a series of slides that I am going to run through very quickly just to give you an idea of what I consider to be the major project phases and tasks.

I think we begin with the perceived need or opportunity and I say that because with something like GIS, I think we have moved beyond problem solving. It used to be that when you designed a system or you had to implement a computer system, the first thing you did was you did a problem definition. We had some clear problem that the organization had to have solved. I don't think any of you have any burning problems or the business would suddenly stop tomorrow if you didn't have Geographic Information Systems. However, there probably is an opportunity here to improve what you are doing currently.

We need to look at the feasibility, because a great concept is of no value if it's not cost effective. There's that term again - it keeps rearing its head. We need to design it, implement it and maintain it. Let me just run through quickly some of these steps.

We begin by defining the needs and developing concepts, usually this results in an educational process, because the user doesn't really know what it is he wants to do. Don Reimer mentioned this this morning and there are some mechanisms that can be used, such as pilot projects, that we can use to help bring some experience into the hands of you and your staff.

We then identify some applications, develop a draft strategy, do a cost benefit analysis or a return on investment, and end up with some sort of a feasibility for the overall process. What's going to happen to the organization, how much it's going to cost, are we going to derive enough benefits to justify those costs. We then select some applications that have come about as the result of further looking at those concepts. Having determined which ones are feasible and cost effective, we then look at the data requirements, we look at the functions that have to be performed by the new system, we develop some functional specifications and an implementation plan and that leads us to our design.

Having our design in place, we then want to select the hardware and software that will be able to satisfy our data requirements, will run the functions that we are interested in, will allow us to implement our applications. We then need to load the data, we may have to write a little bit of custom software - usually what we get when we buy a Geographic Information System is in fact a tool box. I often make the analogy of a program compiler. It's a very sophisticated program compiler, but you still need to compile the commands into specific applications unless you want everybody in the organization to know how to use it at the fundamental level. Then there is installation, training and the system is basically implemented.

With it in place, we need to maintain the database, we need to maintain the software and hardware and we need to have some mechanism for ongoing system evaluation. Is it still performing the way it ought to? Is it meeting our objectives? Has the organization changed? Do we need to go back and make some adjustments to our database design or add new functionality to the software? Do we need more workstations?

These all get integrated into a process that is continuous, although I presented it as some discreet steps, in reality what ends up happening is we move through this in a continuum and sometimes in fact we may need to go back to an earlier step, rethink something we've done or make some modifications to our strategy.

There are some techniques that we can use that are proven now. Most of them have been borrowed from the business sector. The banks and financial people have been building big systems a lot longer than we have and there's a great deal that we can learn from what they've done. It is important to have a good organizational structure. You need to have a fulltime project manager, somebody has to take responsibility for making this happen. You need to follow structured design techniques that include data analysis and functional analysis with a heavy reliance on diagrams in order to make the system simple and understandable for the users and management.

Two other mechanism you may want to consider, depending on the complexity and size of the project is pilot projects and prototype, and I will deal with each of these as well.

In terms of the organizational structure then, you want to have some sort of management or steering committee, to which the project manager reports, and that steering committee should cut across the organization and include all of those divisions that are going to be impacted by the new system. There should be a commitment by senior management to make this process work and for them to supply an adequate amount of resources, time and interest in the system development. Reporting should be to some sort of a technical advisory committee that facilitates the process. Make sure that the project manager, the systems analyst, the people who are going to be designing the system, have access to all of the information about the organization that they need and that they are getting the support that's required.

In terms of data analysis, what we are looking at is a rigorous view of what data elements are used to support the various functions that the organization does. We want to bring it down to a very low level. We want to granularize it down to the data element so that we can determine redundancies and where they're going to be used. We want to have as much data independence as possible, we want to do something called strategic data planning, again I am not going to get into all of these topics at length here, but refers to looking at what data is being used in support of what functions and across how many places in the organization, where should it reside, who should be collecting it, who is responsible for maintaining it? - Those kinds of issues.

There has to be end user access to the whole process. The end user has to be part of the process of doing the data analysis, because he is the one who best understands the data, and there are some tools that can be used such as data dictionaries for helping us with this and there are a lot more new tools that are coming along.

Functional analysis consists of taking the current organization, breaking it into the divisions or portions that perform the various functions, identifying those functions and developing a physical model of what the organization does currently. So we end up with divisions A, B and C and all of the functions that they perform, how they relate to each other.

That then allows us to develop a logical model. We'd go independent to the organizational structure and say, "This is what the organization really does. Here are all of the functions that the organization performs and will the grouping be the same after we have implemented the system or will it in fact change - should it change?". That process is called abstraction and it is an opportunity for us to take new goals and objectives from management or from within the operating level of the organization and incorporate these into the system, abstract what is being done currently, think about it in other words - look at it in new ways, and develop a new logical model of the functions - how they should be grouped. That then relates to some organizational change which needs to be discussed within the organization and then when agreed to determine where those functions are going to reside and who is going to be responsible for them - a new physical model of the organization - a new organizational chart in effect.

Documentation. The whole process has to be documented, of course, as you go.

Here's a very quick view of the two halves fitted together. We've got a current physical model, that we do something called functional decomposition, where we take the organization and break it down into its parts and functions, the logical model, the abstraction of it, the new physical model. This occurs concurrently with the rigorous data analysis I talked about. We look at data usage, current data flow diagrams are produced, we look at the data model that has to be in place to implement the logical model, we develop a new data flow diagram that leads us to a database design and ultimately the new system.

One of the things that we can use when we get into very complex circumstances, where we are really not sure of what we are doing yet, is pilot projects. Pilot projects are nice because they give us a bench test, some kind of an environment that we can try things without having to make big commitments. It's also a good opportunity for education of the end user and management in terms of what really may be possible. We tend to work on small test areas with minimal data loading. We talked about data loading being the most expensive portion of it, that being the case, we want to make sure that we are not wasting money loading data if it isn't necessary. This creates an environment where we are spending very little money, it creates an environment where failure is tolerated. We are allowed to make mistakes as long as we learn from those mistakes. Overall, we are looking at a small investment. These may be desirable actions, or in fact, you may be ready to move ahead without doing a pilot project.

The next step and not everybody differentiates between these. I like to differentiate between them - I say that a pilot project is more of an experiment and that the prototype is a working model of your production system in a production environment. It's now running parallel to your manual system within the division that's going to be using it and you can evaluate and test it in terms of how well it's going to work. This is particularly more important in government than it may be in private industry. In government there is a bigger concern, I think, for ensuring that the new systems are going to continue to perform the mandated functions of the organization. If you switch over and suddenly a bunch of functions fall between the cracks, you can be sure that somebody somewhere is going to have something to say about it.

Again, part of the orientation is for end user education. It is still a learning environment - if the system doesn't perform perfectly or if someone doesn't know their job real well yet, it doesn't matter because you have a parallel manual system. Again therefore, limited impact in cost.

We can put together an implementation process that includes pilot projects - tying together some of the early stages that I talked about, where we have a feasibility study that leads to a design, the design is tested in a pilot project, we evaluate the pilot project and if it worked, we go on to a prototype potentially or we go back to the design, rethink it and modify the pilot project. The prototype is in the same vein, we can run the prototype, evaluate it if we like it, and if it seems to work, we put it into production.

We can take both pilots and prototypes and string them together over time. What we have is increasing application complexity and cost of the individual applications, not in total, but as we move across the diagram to the right, the projects that are over there are more expensive. Each of those lines, the blank boxes there, represent the same process that you see in the first two boxes that are labelled, and we are moving through time as we advance down through the slide.

What we do then is we initiate a study from a perceived need or opportunity, we do the feasibility study, it seems to indicate that this is a good idea, we undertake a design, the design leads to a pilot project that moves into a prototype phase and now we are into the implementation in the design process. So what we have is parallel streams of activity, one - a management activity, a management and design - a paper study if you like, and the other, a real activity in a system. The implementation leads to the prototype, the results of the prototype to a production system and then the maintenance process on the production system.

However, what we find is that as you move through the pilot project, you probable identify new perceived need or opportunity, a new idea comes along, that initiates the process again. What this does is it facilitates incremental implementation, because we learn as we go. We can therefore begin with a relatively simple application that doesn't cost very much money, that has a reasonable return on it. The knowledge that we gain from implementing the earlier systems can be applied to the later ones when updating the data, the programs, the hardware and software. It gives us an incremental process for managing change and for learning as we go at a rate that we feel comfortable with.

Just to quickly review the basic principles then.

End User Involvement - I can't stress this enough. This is absolutely the most important aspect. There isn't any systems analyst or consultant or data processing person that you can bring into your organization that's going to know it as well as your people. Your staff are the only ones who really know how your organization functions or what your company does. You need to have them to design the system, but they don't have all of the skills that are necessary to do the design. So you need to build some sort of a project team.

Effective Communication - There has to be effective communication because really that's what it boils down to - someone is telling someone else what it is they want out of the system. Diagrams are very good for doing that because you can see the flow of activities. Just in the same way that we have with slides here today, it is easier to visualize how the one stage flows to the next stage.

Clearly Stated Objectives - There have to be clearly stated objectives. If you don't know what you want the system to do, then it's never going to do it, I can guarantee it.

Education

End User Support

Well Defined Long Range Concept - If you are going to have pilots and prototypes, where you are going to enter into some sort of an incremental design, the danger is that it increments forever, that it in fact never gets finished or doesn't lead you to where you want to be. The way you can get around that is to have a well defined long range concept - have a vision of the future.

Incremental Implementation - I talked about this from a costing perspective and from a changing management perspective, being able to control the impacts on the organization.

Identifying Appropriate Applications - You want to have applications that are relatively inexpensive to implement but that have a high return, either economically or in visibility or in solving some problem that your organization has that it couldn't do prior to having the technology. This builds management commitment and support for proceeding with the system. Pilots and prototypes are vehicles that can be used for doing that.

Measurable Management Plans - You want to have measurable management plans. It is not enough to have goals and objectives or to have a work plan that says what it is you're going to do over a period of time. There has got to be measurable landmarks in there - points that can be measured, both in terms of dollars and time so that people can feel comfortable that the project is being well managed, and there must be some sort of a structured design process within which it is being done because otherwise it just waffles all over.

In summary then, with a structured design process, you spend more money on development up front but you spend less money in the long run on operation. With no design, you spend less money up front but you spend a lot more money in the longer run on operation because you are constantly having to go back and do fixes to the things you didn't get right in the first instance.

Knowledge and experience lead to good design which leads to lower cost and a better system. I think that's really the bottom line of what we're talking about. The knowledge can be obtained from symposiums and conferences, journals, textbooks, hardware and software vendors and consultants and forums such as the one that we've had this week are excellent places to pick up a lot of this information. There are some basic principles that you can learn in half an hour that can save you thousands of dollars.

I really meant for that to be context, and that's why I skipped through it rather quickly. I didn't so much want to give you a lecture on system implementation or project design as I did want to share with you the fact that there are some existing principles, there are some things that are well known and are understood that can make a difference in how it is you implement the system.

Now I would like to bring this discussion into context with the items that were identified during the week. The ones that we started out with on the overheads. There are some things that I observed as we proceeded that relate to the issues and observations that I had, and what I would like to do is just compare and contrast here.

OPERATION / INFORMATION / DECISION SUPPORTS SYSTEMS

Ken Buker says that an "operation system is a system for the routine processing of data and the answering of pre-defined and limited queries". It means that the system is designed in such a manner that you know everything it's going to do on every occasion when somebody sits down in front of it before they do it. There are no unstructured queries, no ad hoc questions are asked, examples of this are bank teller systems and airline reservation systems. You don't go up to a bank teller machine and ask it what the weather is going to be like. They knew exactly what you're going to do at that station and it handles those processes very well.

An information system, on the other hand, is a system in which the information needs of the user are not precisely defined at the time of which the system is being designed. So there is a fundamental difference - one is designed for flexibility, the other is designed for performance, working with very large batch jobs.

Decision support systems are not really well defined or understood yet. It's difficult to find a clear definition, probably because the industry hasn't really developed enough for them to really know what they are yet. The closest definition I could find was that it's an information system, designed for unstructured use, which is sort of like the information system, dealing with unanticipated information requests, driven by powerful end user languages. So what I interpret from this is that a decision support system is, in fact, an easy to use information system that sits on the desk of the decision maker and you've now removed some of the steps that lie between the answering of the query and the making of the query. You don't have to go down to your information services department now and ask the question and have somebody put the request in.

I apologise as this is probably difficult to read, but what it refers to is the comparison of the three systems. I mentioned that an operation system, an example of it is an airline reservation or a bank teller system. There are pre-defined tasks, decision roles and transaction flows. What that means is that you know exactly what data is going where, what database it resides in and what data is required to answer a specific query and all of it is designed to happen very quickly. It's often very high volume. We're talking about the main purpose of an operation system is to remove huge amounts of data very quickly and efficiently. It's the bulk of conventional data processing. Looked at on a world scale, it probably accounts for 80% of all of the data processing that's done. The main payoff is efficiency, fast turnaround, quick response to simple queries, and staff reduction. Those are the objectives here.

Main design concern is the efficiency of bulk operations - we want this thing to run fast, process thousands, millions, hundreds of millions of requests a day. Very well defined functions, a highly structured database and the users tend to be clerical or technical, first line management people. We're not talking here about something that resides on the desk of a decision maker, nor are we talking about ad hoc reports.

An information system by contrast, an example of it is a Management Information System, deals with unstructured, unanticipated queries. It's a lower volume of transactions - we're not concerned here about being able to process hundreds of millions of transactions. The main function is to generate reports - we're trying to synthesize a bunch of information. The main payoff is better information and the main design concerns are user friendly access and effectiveness for management operations. The information reports that come out have to somehow be related to the management functions of the organization. The users are middle management or senior management aides who go down and process a report.

Decision Support System is another step along that same continuum. An example is the stock market analysis system. Although any of you who follow the market, know how well the systems are working currently, when they caused the last crash that we had. Largely unstructured use; not fully anticipated queries; low volume of transactions; maybe highly complex transactions - fewer of them, but highly complex; main function is to support decision making, does not make decisions but it supports decision making; the main payoff is better decisions; the main design concerns are analysis of the decision process; content and reliability of the support data; user friendly access; it may involve some predictive models, in fact, in order to be able to provide us with some decision support; and the users are decision makers and aides.

When I listened to the discussions this week and I heard the kinds of things we want to do, and in Glen Jordan's talk earlier, where he talked about getting into modelling, I think it is relatively clear that what we're talking about in the implementation of GIS is a system that falls somewhere on the side of a decision support system. There may be some other functions in fact, that fall into information systems, and there are certainly aspects of GIS that can be applied to operation systems, but the big payoffs are probably going to be in the decision support. What that means in terms of design is that there is no point in looking at getting a lot of flow through or having highly structured requests and spending a lot of time figuring out exactly what functions have to be built in to it because we know it's going to be unstructured in the first place. We need to design for flexibility.

Now having said all of that, I want to make sure that I don't leave you with the impression that operation systems don't have a place or you need to have three systems if you are going to the same thing. We don't want to confuse operations systems' goals with information or decision support systems' goals. It is very important that if you design a decision support system based on goals for an operation system or vice versa, you are going to end up with systems that aren't going to satisfy your requirements.

By the same token, development of one type of system doesn't preclude the need for other types of systems. Your organization or your company probably has some bulk processing that needs to be done - payroll for example. You don't want to design an information system for doing those bulk processing functions because it's not going to work well. Different systems can share the same databases. So you can have different functions running on the same database but you're going to have to have a design, a structure in that database if you're going to run all three kinds of systems. That's not impossible, but it has to be done differently.

We need to determine the level of integration of the databases used to support the various systems. So we want to look at how integrated they have to be because, in fact although they can, perhaps there is no need to integrate them at all. Maybe your payroll has absolutely nothing to do with your harvesting operations and there's no reason why those two databases should be integrated.

MANAGING CHANGE

I would like to then come to the next topic, which I said was managing change and that's what we're really talking about here, and it's well known and it's been stated by many people. The implementation of computer technology results in changes within the institution in which it is implemented. That is a well-documented known fact. This is not a suggestion or an off-the-wall idea, it's well proven. You, as managers then, or your organizations, have four ways that you can deal with that change. You can ignore it and hope for the best; you can try and stop it - and that's probably unlikely, somewhere in your organization, there's some keener who will want to proceed with GIS regardless of what you do; you can react to it and be event driven for the entire time; or you can try and manage it and develop strategies and be pro-active about what it is you're going to do because it's going to happen anyway.

Information Management

Part of managing change is information management. I started out the talk this afternoon in speaking about information resources management. Then we took a quick look at the slides that went over one process for arriving at it. What I've tried to do here is to scale it down to some relatively simple points that really get at the salient aspects of doing structured

ADAMSON, MARK
CANADIAN FORESTRY SERVICE
5320 - 122 STREET
EDMONTON, ALBERTA
T6H 3S5

ALEXANDER, MARTIN
CANADIAN FORESTRY SERVICE
5320 - 122 STREET
EDMONTON, ALBERTA
T6H 3S5

ALLAN, DOUG
CANADIAN FORESTRY SERVICE
5320 - 122 STREET
EDMONTON, ALBERTA
T6H 3S5

ALLEN, DIANNE
EXHIBITOR
INTERGRAPH
3115 - 12 STREET N.E.
CALGARY, ALBERTA
T2E 7J2

AMIRAULT, PETER
CANADIAN FORESTRY SERVICE
5320 - 122 STREET
EDMONTON, ALBERTA
T6H 3S5

ANDERSEN, STEIG
DEPARTMENT OF RURAL ECONOMY
1598 WELLINGTON STREET EAST
SAULT STE. MARIE, ONTARIO
P6A 2R7

ANDERSON, GREG
ALBERTA FOREST SERVICE
ROCKY/CLEARWATER FOREST
10 FL., BRAMALEA BUILDING
9920 -108 STREET
EDMONTON, ALBERTA
T5K 2M4

ANDERSON, PHIL
ALBERTA FOREST SERVICE
TIMBER MANAGEMENT BRANCH
10TH FL., BRAMALEA BUILDING
9920 - 108 STREET
EDMONTON, ALBERTA
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GRANDE PRAIRIE, ALBERTA
T8V 3A3

WEISS, MARV
MAPPING BRANCH
LAND INFORMATION SERVICES DIVISION
4949 - 94B AVENUE
EDMONTON, ALBERTA
T6B 2T5

WELLS, R.E.
PEDO-ECOLOGIC CONSULTANTS LTD.
10845 - 32A AVENUE
EDMONTON, ALBERTA
T6J 3B8

WHITLEY, BONNIE
ALTA. FORESTRY, LANDS & WILDLIFE
LAND INFORMATION SERVICES DIVISION
4949 - 94 B AVENUE
EDMONTON, ALBERTA
T6B 2T5

WIART, RAOUL
UNIVERSITY OF BRITISH COLUMBIA
FORESTRY
2357 MAIN MALL
VANCOUVER, B.C.
V6T 1W5

WILLIAMSON, AL
TECHNOLOGY, RESEARCH AND
TELECOMMUNICATIONS
12TH FL., PACIFIC PLAZA
10909 - JASPER AVENUE
EDMONTON, ALBERTA

WILLIAMSON, GRANT
ALBERTA FOREST SERVICE
GRANDE PRAIRIE FOREST
10TH FL., BRAMALEA BUILDING
9920 - 108 STREET
EDMONTON, ALBERTA
T5K 2M4

WILLIS, GORDON
EDMONTON REGIONAL PLANNING
COMMISSION
SUITE 600, 10025 - 106 STREET
EDMONTON, ALBERTA
T5J 1G4

WILSON, BEVERLY
8722 - 81 AVENUE
EDMONTON, ALBERTA
T6C 0W6

WOLLIS, HUGH
ALBERTA FORESTRY, LANDS & WILDLIFE
FISH AND WILDLIFE DIVISION
2ND FL., BRAMALEA BUILDING
9920 - 108 STREET
EDMONTON, ALBERTA

WRIGHT, PETER
CANADIAN FORESTRY SERVICE
5320 - 122 STREET
EDMONTON, ALBERTA
T6H 3S5

YANG, RICHARD
CANADIAN FORESTRY SERVICE
NORTHERN FOREST RESEARCH CENTRE
5320 - 122 STREET
EDMONTON, ALBERTA
T6H 3S5

ZWIERINK, MEL
MONENCO CONSULTANTS
801-6TH AVENUE, S.W.
CALGARY, ALBERTA
T2P 3W3